VOLUME 64 [W. B. No. 1183] NUMBER 5

MONTHLY WEATHER REVIEW

MAY 1936

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MONTHLY WEATHER REVIEW

Editor, EDGAR W. WOOLARD

VOL. 64, No. 5
W. B. No. 1183

MAY 1936

CLOSED JULY 3, 1936
ISSUED AUGUST 10, 1936

TEMPERATURE SURVEY OF KITTITAS COUNTY, WASH.

By FLOYD D. YOUNG and FRED A. BAUGHMAN

[Weather Bureau, Pomona, Calif., February 1936]

The history of fruit growing in western United States is replete with examples of the planting of orchards in wrong locations. Poor soil, insufficient rainfall or irrigation water, excessive wind, poor drainage, and similar factors all have had their part in necessitating the eventual abandonment of thousands of acres of fruit trees, with a resulting loss of millions of dollars invested; but probably the greatest loss has been caused by the planting of orchards in areas of excessive frost hazard. Although the existence of so-called thermal belts on hillsides has been recognized since at least before the middle of the last century, and the mechanical aspects of air drainage have long since been accurately analyzed, the frost hazard has until very recently been almost completely ignored in planting orchards. Orchards planted in frost pockets usually lead to the bankruptcy of a long succession of owners before they are finally abandoned.

Temperature surveys have been conducted in old-established fruit-growing districts on the Pacific Coast for many years in connection with the Weather Bureau's Fruit-Frost Service, but the application of the information obtained has been limited to delineating areas in which artificial frost protection is needed, or to demonstrating the advisability of abandoning individual orchards in which the frost hazard is hopelessly great.

Irrigation development of the Yakima River Valley in Kittitas County, Wash., began in 1888, with the construction of the "Town Ditch", which furnished water for land on the valley floor north of the river. The West Side Canal, constructed in 1891, and the Cascade Canal, constructed in 1904, increased the total irrigated area to approximately 26,000 acres, and brought water to practically all of the good land at lower levels in the district. Scattered orchards were planted throughout most of the valley in the early days, but at present only a small acreage immediately below the old Cascade Canal on the southern edge of the valley remains. Excessive frost hazard has caused the removal or abandonment of the rest.

When the United States Reclamation Service began to plan an extensive new irrigation system to bring water to 72,000 acres of hillsides and benches high above the valley floor, at a cost of $9,000,000, practically doubling the area under irrigation, it was decided to take all possible steps to insure the success of the individual farmer in taking up land under the new project. Messrs. Strahorn and Kocher of the United States Department of Agriculture made a very accurate and detailed soil survey of all the land, making use of extensive borings and test pits to determine the different classes of land and the soil types; and the Weather Bureau was requested to conduct a 5-year temperature survey. Kittitas County cooperated in the temperature survey work, purchasing the instrument shelters and carrying a portion of the annual expense.

DESCRIPTION OF THE DISTRICT

Kittitas County is located near the geographical center of the State of Washington. The irrigated area, lying along the Yakima River on the eastern slope of the Cascade Mountains, is a basin about 25 miles long and 11 miles wide, extending in a northwest-southeast direction. It is surrounded by hills that are from 3,000 to 4,000 feet in elevation. The Yakima River leaves the basin through a deep and narrow canyon about 10 miles south of Ellensburg. Most of the soil in the irrigated area is of deep volcanic ash, but there are large areas of stony land, with soil too shallow for orchards. The valley floor, watered by the old irrigation systems, is given over at present almost entirely to dairying and the growing of grain and forage crops. Irrigation water comes from the Cascade Mountains and is stored in three large artificial lakes near the headwaters of the Yakima River, constructed at a cost of an additional $2,000,000. The valley naturally is semidesert, the annual rainfall at Ellensburg averaging about 9 inches.

The land under the new Reclamation Service project, on which the temperature survey was conducted, all lies on moderate to steep slopes or benches some distance above the valley floor. At the time the temperature survey was begun in 1931 the area had never been cultivated, and was covered with a heavy growth of sagebrush. Roads were few and poor, and some difficulty was experienced in devising means to reach the various survey stations to make the temperature readings. During the 5-year period, however, most of the land was sold or homesteaded, sagebrush was cleared, the land cultivated, and good main roads were constructed. During the last two seasons of the survey a large portion of the land was planted to grain, alfalfa, seed peas, and other crops.

HOW THE SURVEY WAS MADE

The area to be reclaimed by the new irrigation project was too large to be covered adequately by the few temperature stations for which equipment was available, and

after a conference with Reclamation Service officials all but the areas having the best soil conditions were eliminated. As the survey progressed, stations at which it became evident that temperature conditions were unsuitable for the growth of anything but the hardier crops were eliminated, and the instrumental equipment moved to new locations which it previously had not been possible to cover adequately. Twenty-nine temperature stations were kept in operation throughout the period from about March 20 to May 20, during the five spring seasons from 1931 to 1935 inclusive, each equipped with a standard fruit-region instrument shelter, minimum thermometer and thermograph. The minimum thermometer was approximately 4½ feet above the ground at all stations.

Station locations were selected with great care, keeping in mind areas already known to be marginal due to excessive frost hazard. Topographically similar areas, such as are to be found on the north side of the district, required relatively few stations, while topographically irregular areas, such as the Edgemont and Badger Pocket sections, with good soil, were allotted a greater number of stations per unit of area. Since little of the surveyed area was fenced, it was necessary to protect the instrument shelters from injury by stock by building barbed wire inclosures. A trip of 140 miles was required to visit all the stations.

With very few exceptions, caused by emergencies, minimum thermometers at all the survey stations were read on each day following the occurrence of a temperature of 32°, or lower, at any station. Thermograph records were checked for both time and temperature at each reading. On the few dates when it was not possible to visit all the survey stations, the minimum temperatures were taken from the thermograph records.

One station, number 1, was established in an abandoned apple orchard on the valley floor as a check on temperature conditions definitely known to be unsatisfactory for fruit production. Station number 3 was located in another apple orchard on a slight slope a few feet higher than the valley floor in the southwestern part of the district, which had not been abandoned but which production records showed to be submarginal owing to excessive frost hazard. Station number 2 was located in an apple orchard higher on the slope, with better air drainage, which records showed to have been consistently profitable. A comparison of temperature records obtained at other survey stations on the project with those obtained at stations 1, 2, and 3, should make possible a definite classification of different areas with regard to their suitability for apple growing (see tables 1 and 2).

Throughout the period of the survey, complete daily observations of current temperature, wind direction and velocity (estimated), amount, type, and direction of clouds, maximum and minimum temperature, dewpoint, and relative humidity, were made at station 1 daily at 4:40 p. m., Pacific time, the regular time of making evening observations at all Weather Bureau stations in the country. In addition to their climatological value, these records will be invaluable in case a minimum-temperature forecasting service for the district is undertaken at any future time.

The locations of all the temperature survey stations in the district, as well as the Ellensburg cooperative station, are shown in figure 1. As detailed a description of the various locations as it is possible to make is given below.

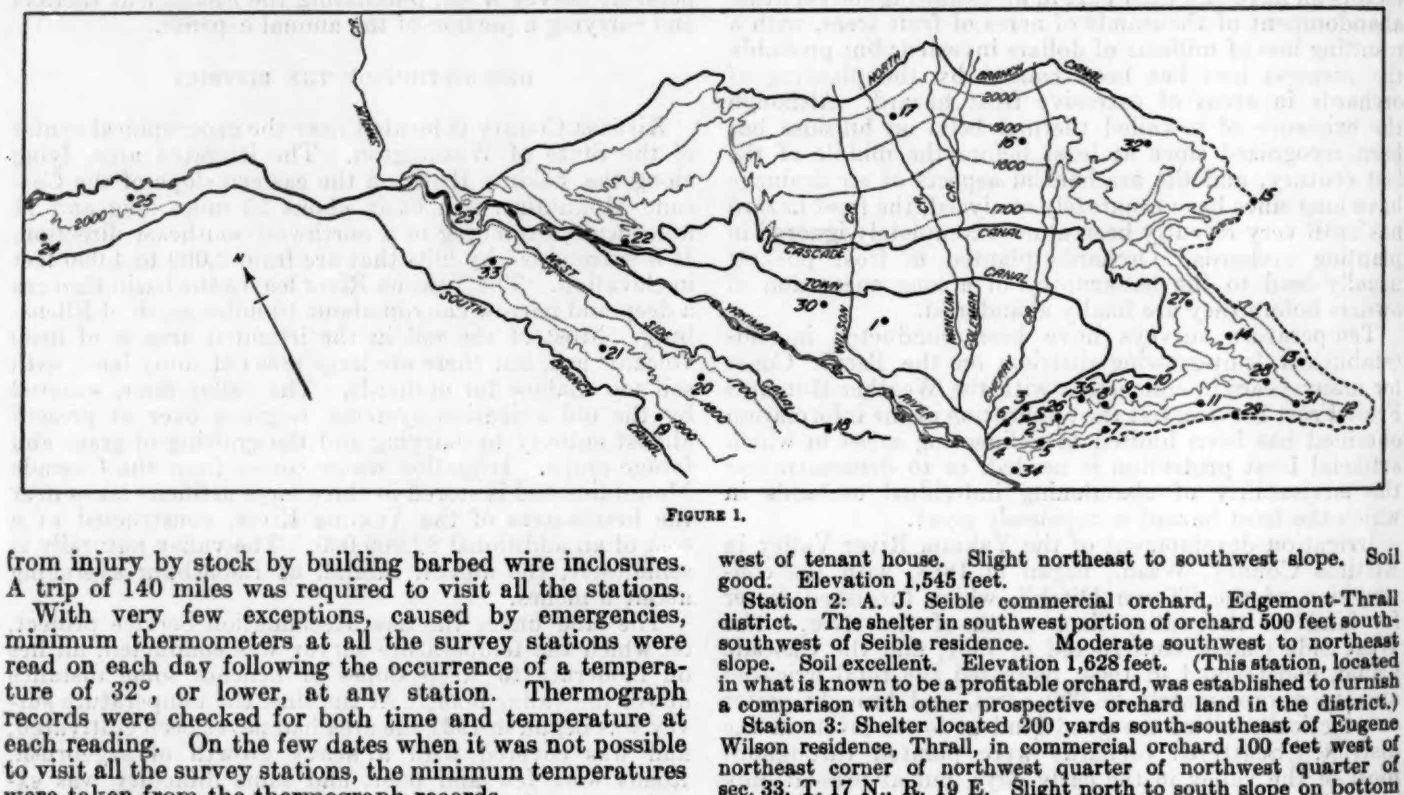


FIGURE 1.

DESCRIPTION OF TEMPERATURE SURVEY STATIONS, KITTITAS COUNTY, WASH., 1931–35

Station 1: Alva Bull Lone Star Ranch, 1¼ miles east, ¾ mile south of Ellensburg. Shelter in small home orchard 40 feet north-west of tenant house. Slight northeast to southwest slope. Soil good. Elevation 1,545 feet.

Station 2: A. J. Seible commercial orchard, Edgemont-Thrall district. The shelter in southwest portion of orchard 500 feet south-southwest of Seible residence. Moderate southwest to northeast slope. Soil excellent. Elevation 1,628 feet. (This station, located in what is known to be a profitable orchard, was established to furnish a comparison with other prospective orchard land in the district.)

Station 3: Shelter located 200 yards south-southeast of Eugene Wilson residence, Thrall, in commercial orchard 100 feet west of northeast corner of northwest quarter of northwest quarter of sec. 33, T. 17 N., R. 19 E. Slight north to south slope on bottom of considerable draw. This station established to furnish basis for comparison of other localities in the district with one where conditions are thought to be marginal. Soil very good. Elevation 1,538 feet.

Station 4: Edgemont-Thrall 80 feet west and 220 feet south of the northeast corner of the northwest quarter of the southwest quarter of sec. 32, T. 17 N., R. 19 E. Steep south-southwest to north-northeast slope, soil excellent. Elevation 1,775 feet.

Station 5: Edgemont-Thrall, 500 feet east, 350 feet south of southwest corner of sec. 33, T. 17 N., R. 19 E. Steep south to north slope, soil excellent. Elevation 1,828 feet.

Station 6: Edgemont-Thrall, 50 feet south of county road, 200 feet east of Alva Bull farmhouse, northeast quarter of northwest quarter of sec. 32, T. 17 N., R. 19 E. Slight south to north slope, soil excellent. Elevation 1,493 feet.

Station 7: Edgemont, 200 feet west, 200 feet south of center of sec. 3, T. 16 N., R. 19 E. Soil excellent, moderate south to north slope. Elevation 1,973 feet.

Station 8: Edgemont, station 400 feet east and 150 feet north of southwest corner of sec. 35, T. 17 N., R. 19 E. Soil excellent, steep west-southwest to east-northeast slope. Elevation 1,818 feet.

Station 9: Station located 75 feet east of Lawrence Gehlen farmhouse or 100 feet southeast of southeast corner of sec. 35, T. 17 N., R. 19 E. Gentle slope from south-southwest to north-northeast with good soil. Elevation 1,741 feet.

Station 10: Edgemont, 200 feet east, 100 feet south of northwest corner of sec. 1, T. 16 N., R. 19 E. Gentle southwest to northeast slope. Soil excellent. Elevation 1,694 feet.

Station 11: Edgemont-Badger Pocket, 500 feet east, 500 feet south of northwest corner of sec. 7, T. 16 N., R. 20 E. Soil very good, moderate south-southwest to north-northeast slope. Elevation 1,903 feet.

Station 12: Badger Pocket, 800 feet east, 500 feet south of northwest corner of sec. 22, T. 16 N., R. 20 E. Soil good, gentle local slope from southwest to northeast. Elevation 2,013 feet.

Station 13: Badger Pocket, 1,000 feet west, 150 feet south of center of sec. 10, T. 16 N., R. 20 E. Soil fair, gentle and extensive east to west slope. Elevation 2,035 feet.

Station 14: Badger Pocket, 400 feet north of southwest corner of sec. 33, T. 16 N., R. 20 E. Soil good, local moderate east to west slope. Elevation 1,851 feet.

Station 15: Johnson Creek Canyon, 2,000 feet northeast of Milwaukee Railroad trestle, about 5 miles east-southeast of Kittitas. Soil very good, station located on bottom of small draw with slight east to west slope. Elevation 2,000 feet.

Station 16: Snodgrass farm, 1 mile east and 2½ miles north of Kittitas. Shelter situated 50 feet southeast of house. Soil fair with extensive gentle northeast to southwest slope. Elevation 1,880 feet.

Station 17: Barre farm, 4 miles North of North Central Highway and 3½ miles east of Ellensburg. Station in very small old orchard, 100 feet southwest of house. Soil fair, extensive gentle north to south slope. Elevation 1,970 feet.

Station 18: McNeal station. Section corner of secs. 15, 16, 21, and 22, T. 17 N., R. 18 E. Soil excellent, moderate to steep slope from southwest to northeast. Elevation 1,751 feet.

Station 19: Catlin farm, 6 miles west and one-half mile south of Ellensburg at end of county road, about 1,000 feet east-southeast of Catlin house. Soil good, slope generally moderate from west to east. Elevation 1,916 feet.

Station 20: Prater farm, 4¾ miles west of Ellensburg on gravel road, 200 feet west of barn on south side of road. Sec. 6, T. 17 N., R. 17 E. Soil good, general moderate southwest to northeast slope. Elevation 1,741 feet.

Station 21: Kilmore farm, 6½ miles west, 1¾ miles north of Ellensburg, 300 feet east of farmhouse in alfalfa field. Soil good with rather irregular moderate slope from southwest to northeast. Elevation 1,832 feet.

Station 22: Dry Creek station, 1,500 feet south, 1,500 feet east of the southwest corner of sec. 7, T. 18 N., R. 18 E. Soil excellent, station on southwest to northeast steep slope representing a rather limited area. Elevation 1,787 feet.

Station 23: Hayward "Flat", a bench 1,400 feet west and 1,280 feet north of southeast corner of sec. 28, T. 19 N., R. 17 E. Soil very good, surrounding territory extremely irregular as to soil and topography. Conditions at this station are representative of numerous other "flats" in the general vicinity. Shelter exposed approximately one-fourth mile west of Walter Hayward farmhouse. Elevation 1,826 feet.

Station 24: Peoh Point station, in old Boedcher home orchard 50 feet northeast of road fork, 1½ miles south of Cle Elum. Soil very good, variable moderate slope, from southwest to northeast at station. Elevation 2,029 feet.

Station 25: Benson siding station, about 50 feet north of barn near county road, 3½ miles east, 1½ miles south of Cle Elum and approximately 1,000 feet west-northwest of Benson siding on Milwaukee Railroad. Soil good, gentle southwest to northeast slope. Elevation 1,911 feet.

Station 26: Edgemont, 600 feet west, 1,200 feet north of southeast corner of sec. 33, T. 17 N., R. 19 E. Soil excellent. Very steep east-southeast to west-northwest slope, with station situated near bottom of a very narrow draw having a south to north slope. Elevation 1,700 feet.

Station 27: Edgar Larson place, near center of sec. 29, R. 20 E., T. 17 N. Shelter about 50 feet west of house, moderate southeast to northwest slope, soil good. Elevation 1,738 feet.

Station 28: Badger Creek station, 75 feet east of west side center of sec. 9, T. 16 N., R. 20 E. West side of section center is at road intersection. Station on bottom of pocket with local slope gentle southeast to northwest. Elevation 1,803 feet.

Station 29: Badger Pocket, 450 feet northwest of southeast corner of sec. 7, T. 15 N., R. 20 E. Station 15 feet north of ca,nal and 400 feet due west of road. Steep south-southwest to north-northeast slope, good soil. Elevation 2,100 feet.

Station 30: Ellensburg climatological station, 100 feet southeast of Kittitas County courthouse. Slope gentle north to south. Elevation 1,520 feet.

Station 31: Badger Pocket, 500 feet north of center of sec. 16, T. 16 N., R. 20 E. Exposure west of county road which joins Badger Creek road about 0.8 miles southeast from Aitken ranch. Moderate southwest to northeast slope, soil fair. Elevation 1,938 feet.

Station 32: Kern ranch in Park District. Station 50 feet northeast from house on south side of North Central Highway and about 9½ miles east from Ellensburg. Slight northeast to southwest slope with good soil. Elevation 2,005 feet.

Station 33: Don N. Smith farm 2 miles west of Thorp. Station situated on a bench from which there is a very gentle northwest to southeast slope, with lower benches to the north and east. Soil very good. Elevation 1,796 feet.

Station 34: Noll farm, 2.1 miles south-southeast of Thrall on Yakima paved highway. Station situated in a small pocket the bottom of which slopes gently from northeast to southwest, soil excellent. Elevation 1,493 feet.

Station 35: Diefenbacker farm, Edgemont, 3¼ miles east and one-half mile south of Thrall; station situated in bottom of rather extensive moderate draw, having a moderate south to north slope. Shelter 300 feet northeast of house. Soil excellent. Elevation 1,733 feet.

NOTES

During the course of the 5-year spring-temperature survey, it was expedient, due to the small number of instruments available for use in such a large area, to make occasional changes in the station locations. The changes made were as follows:

Twenty-five temperature survey stations were established at the beginning of the survey in March 1931.

Station 15 was discontinued April 17, 1931.

Station 26 was established April 17, 1931.

Stations 27, 28, and 29 were established March 24, 1932 on completion of construction of three new instrument shelters.

Station 13 was discontinued June 1, 1932.

Station 28 was discontinued June 1, 1932.

Stations 31 and 32 were established March 24, 1933.

Stations 12 and 32 were discontinued June 1, 1933.

Station 26 was discontinued June 1, 1933.

Stations 33, 34, and 35 were established March 22, 1934.

Station 30 is the regular United States Weather Bureau climatological station for Ellensburg with records throughout the year, covering the past 40 years.

Due to unavoidable circumstances it was necessary to make a change in the original location of the main key station (no. 1) at the beginning of the 1934 season. The previous location was in the Flynn orchard exactly one-fourth mile north from its new location. Topography and soil conditions are identical at the two locations.

Clearing and development of the new land necessitated moving stations 9 and 10 a few yards from their original locations. New locations are representative of the conditions at the original ones.

During the 1934 and 1935 seasons, readings for station no. 24 were made by Mr. Henry Roseburg, one-quarter mile north of original location, both locations representing the surrounding territory suitably.

TEMPERATURE SURVEY DATA

At the end of each spring season a mimeographed report was prepared, giving a detailed description of the season's weather, the locations of the various survey stations, minimum temperatures at all stations for all dates on which the temperature fell to 32° F. at any one station, the duration in hours and minutes of temperatures below 32° F. for each degree for each station, the complete 4:40 p. m. observational data at station 1, fruit tree blossoming dates, and average minimum temperatures at the various stations on nights with large and small temperature inversions. Copies of these detailed reports are available for reference at the central office of the Weather Bureau, Washington, D. C., at the headquarters station of the Weather Bureau Fruit-Frost Service, Pomona, Calif., and at the county courthouse and the chamber of commerce at Ellensburg. This paper is a summary of data contained in these five annual reports.

The temperature survey data can be correlated with the data from the Ellensburg cooperative station, which has a record going back more than 40 years, thus giving at least a fairly accurate picture of frost hazard and length of growing season at any one of the survey stations for any particular year. Temperature records at the Ellensburg

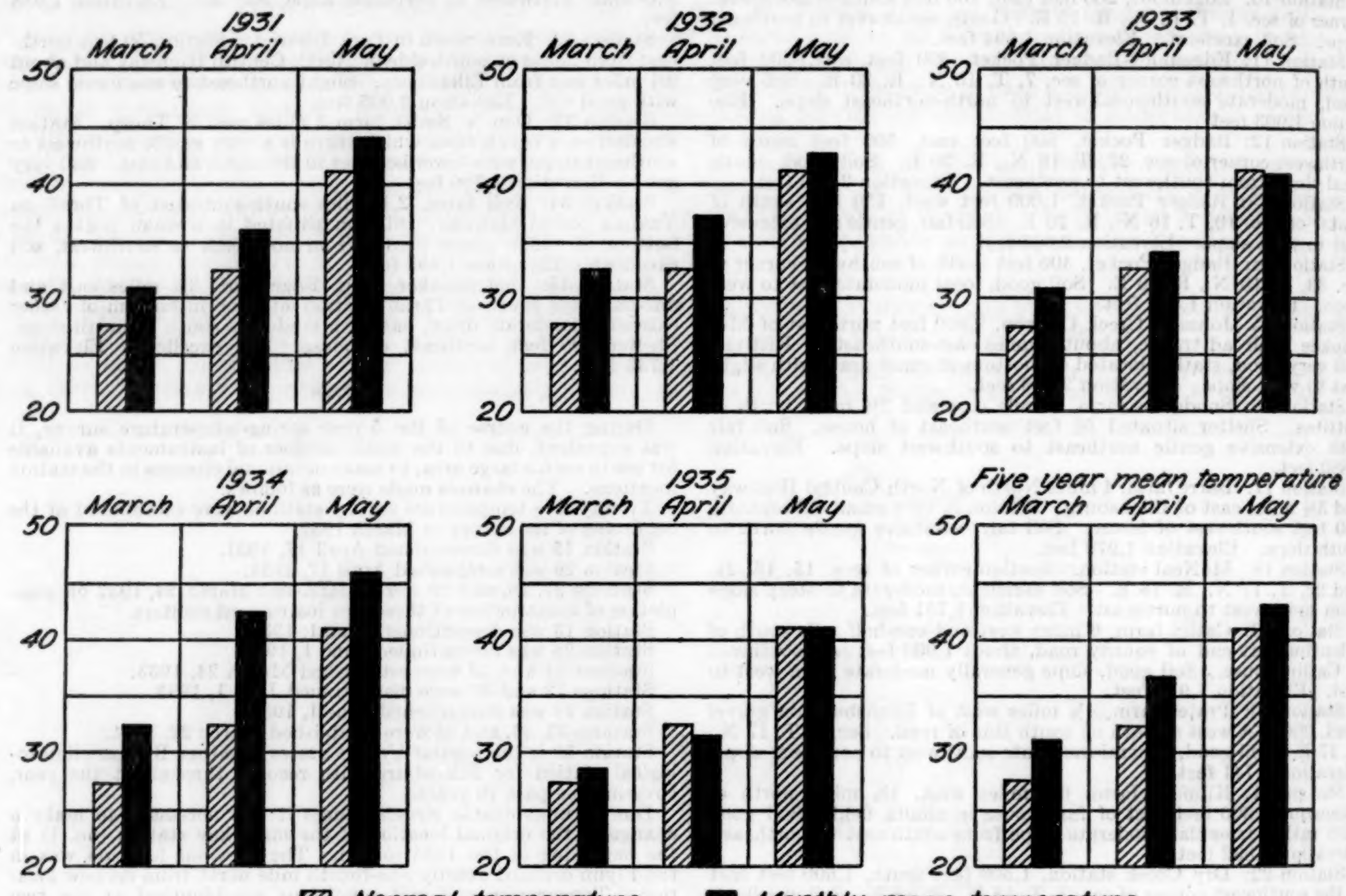


FIGURE 2.—Station 30, Ellensburg, Wash.: Climatological record of monthly minimum temperature and the normal for the spring months.

station will be found in all the temperature survey tables except those showing temperature durations. An examination of the Ellensburg station data during the period of

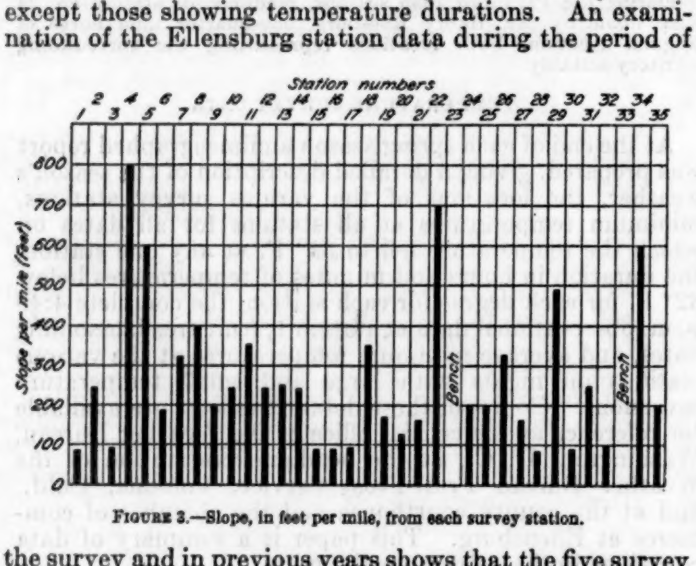


FIGURE 3.—Slope, in feet per mile, from each survey station.

the survey and in previous years shows that the five survey springs were all warmer and more advanced than normal. This is brought out in figures 2 and 4.

During the 5-year period of the survey there were only two frosts which caused material commercial damage to apple crops. The first, on April 19, 1931, just as the apple buds had separated in the cluster, damaged a large percentage of the fruit buds, but due to the excess of bloom reduced the final crops only slightly. The second occurred on March 24, 1934, after 15 days of unseasonably warm weather during the middle of the month had caused rapid development of the buds. Temperatures on this latter date fell as low as 15° in the colder localities, and the apple crop was reduced by 15 to 25 percent in the old-established orchards in the most favorable locations.

The temperature survey was begun each year before any crops grown in the district had developed sufficiently to be susceptible to frost damage, in order to obtain more data to show temperature differences between different locations. The table of blossoming dates on page 164 shows the beginning of the frost season for apples, pears, and peas. As a general rule, crops grown in the district were not sufficiently advanced to be susceptible to frost damage before April 1.

WEATHER SUMMARY BY SEASONS

1931

The season was comparatively mild, with good growing weather and practically no precipitation during April and May. The night of May 19–20 was the last night with heavy frost. Frost on April 18, 19, and 20, with temperatures as low as 20° generally in colder locations damaged fruit blossoms considerably, but due to an excess of bloom, had little effect on the size of the final crop. The pea crop was set back by these cold nights, but no serious damage resulted.

1932

The 1932 season also was comparatively mild, with no seriously low temperatures after crops had advanced far enough to be damaged. There was good growing weather throughout the season, except during a cool period from April 15 to 25. Rainfall was much below normal.

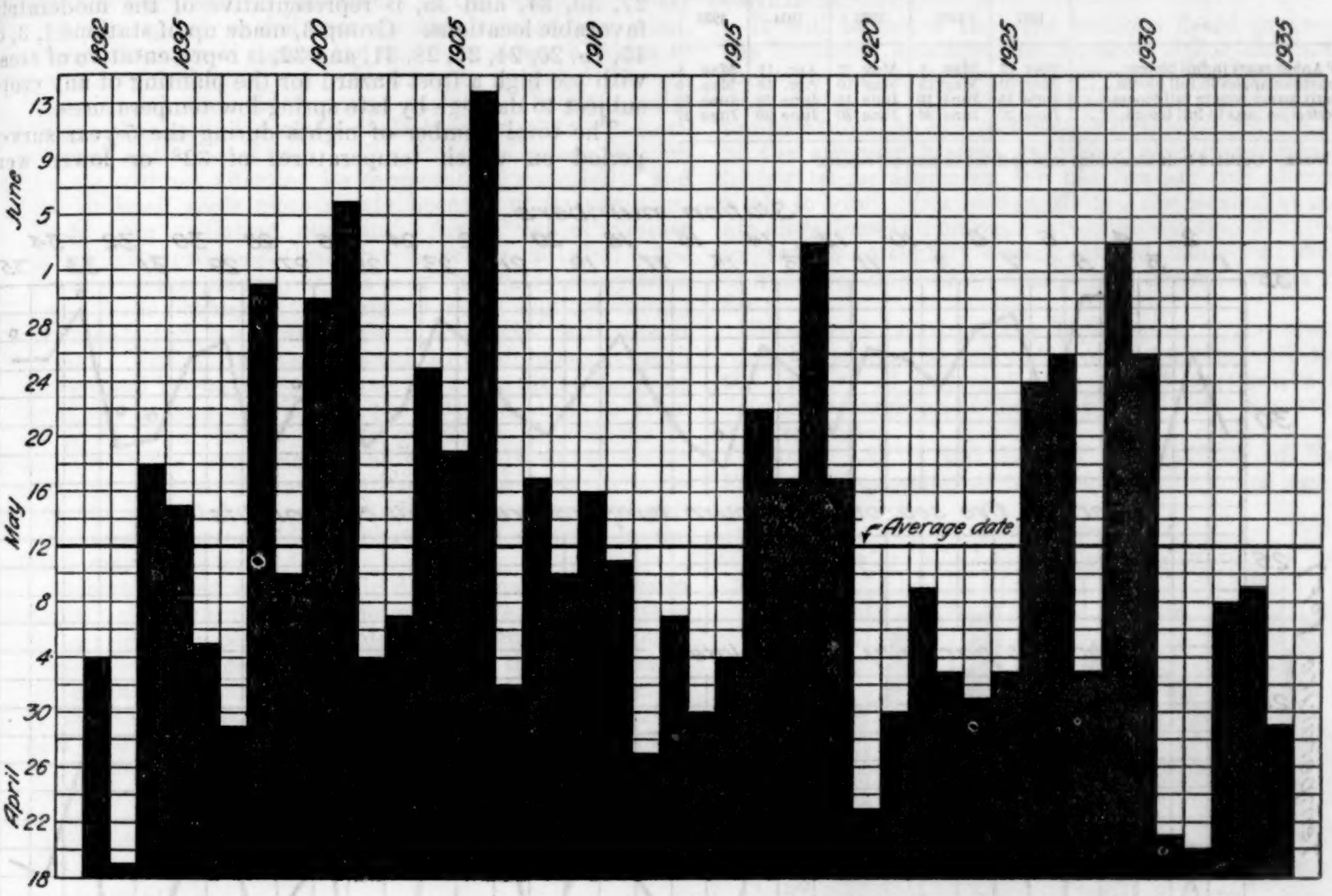


FIGURE 4.—Last date of killing frost in spring, Ellensburg, Wash., 1892-1935, inclusive; 43-year climatological record at station 30.

1933

Preceded by extremely low temperatures in February, the season continued cold and backward, with but one period of favorable growing weather, from April 21 to 30. At several stations the temperature fell to 20° on April 4 and 9. The last general heavy frost occurred on May 19, but frost on June 9 damaged truck crops considerably in scattered colder areas. There were frequent periods of light precipitation, but the total was less than normal.

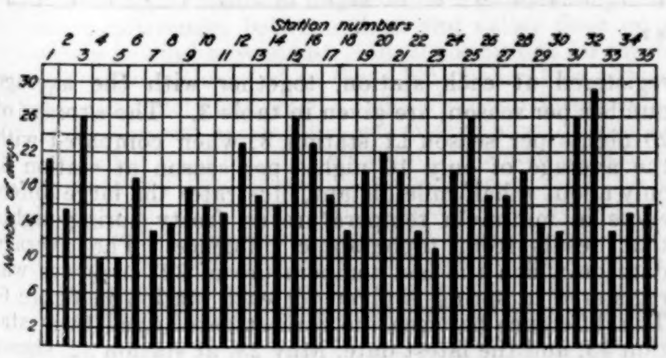


FIGURE 5.—Five-season average number of days 32°, or lower, recorded.

1934

Extremes of both high and low temperature occurred during this season. Temperatures were as low as 15° at some points on March 24, causing 15 to 25 percent damage to the apply crop in colder locations. One station registered 13.2° for a few minutes on this date. The last frost of the season occurred on May 21. During the latter part of April daytime temperatures were as high as 88 to 90° throughout the district, hastening crop growth considerably. A frost on May 9 caused slight damage to tender truck crops in the colder spots. There were 8 days with precipitation during the season and total precipitation was much below normal.

1935

This season was by far the coldest during the period of the survey, although the average minimum temperature at the Ellensburg cooperative climatological station was only slightly below the 28-year normal (fig. 2). Due to continued low day and night

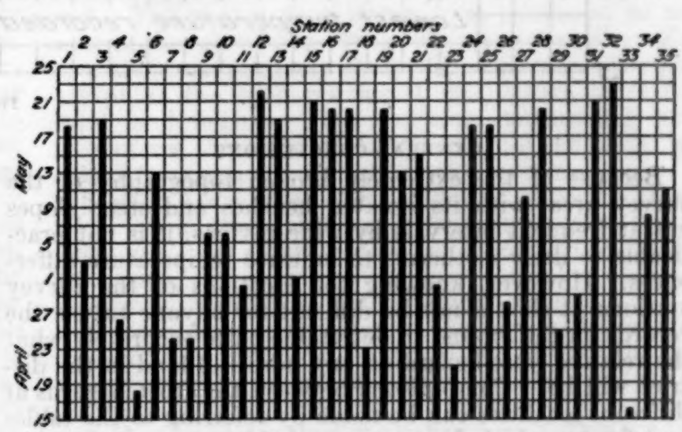


FIGURE 6.—Five-season average date last temperature 32°, or lower, occurred.

temperatures, accompanied by clouds and wind, crop growth was materially delayed. In some cases seed peas rotted in the ground, causing a considerable loss. April 2 was the coldest night at most of the survey stations, minimum temperatures ranging from 6.9° at the coldest station to 18° at the warmest, with many stations record-

ing temperatures below 10°. Precipitation during the season was about one-fourth normal, the major portion falling in the form of snow on the night of March 24–25. At 9 a. m. on March 25 there was 2.9 inches of snow on the ground at Ellensburg.

Summary of blossoming dates, Edgemont district

	1931	1932	1933	1934	1935
D'Anjou pears in full bloom	May 2	May 4	May 2	Apr. 11	May 4
Jonathan apples in full bloom	May 10	May 15	May 16	Apr. 16	May 9
Early sweet peas in full bloom	June 15	June 10	June 14	June 13	June 11
Perfection peas in full bloom	June 20	June 26	June 30	June 30	June 27

NOTE.—Detailed fruit-blossoming records listed in seasonal reports.

The survey locations may be classified in three groups, each with fairly similar temperature characteristics. Group 1, comprising stations 4, 5, 7, 8, 18, 22, 23, 29, and 33, represents the most favorably located areas. Group 2, including stations 2, 9, 10, 11, 12, 13, 14, 17, 19, 21, 26, 27, 30, 34, and 35, is representative of the moderately favorable locations. Group 3, made up of stations 1, 3, 6, 15, 16, 20, 24, 25, 28, 31, and 32, is representative of areas with too high a frost hazard for the planting of any crops subject to damage by late spring low temperatures.

The total number of nights during the 5-year survey period on which temperatures of 32° or lower were registered at each station, together with the average number per season, are given in table 3. The average of 26 nights per season at station 3, when compared with the average of only 10 nights per season at station 5, only about a half mile distant, illustrates the large differences in minimum temperature on frosty spring nights that result from topographic influence. The average date on which the last temperature of 32° or lower was registered in spring is given for each station in figure 6. The difference between the earliest date, April 16 at station 33, and the latest date, May 23, at station 32, shows a growing season beginning more than a month earlier at station 33 than at station 32. Similar differences in temperature undoubtedly exist during the fall season, and the average annual growing season is probably more

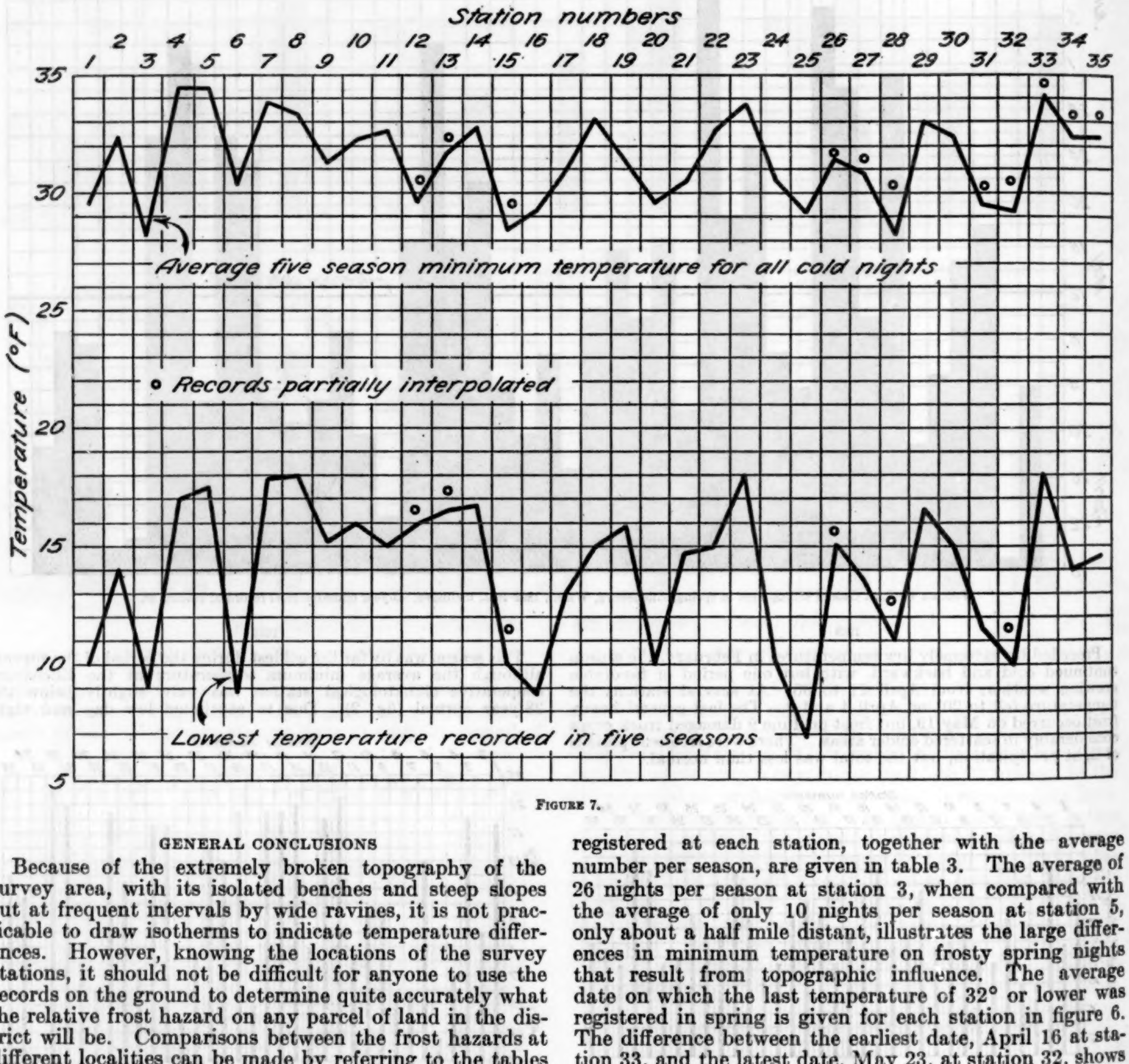


FIGURE 7.

GENERAL CONCLUSIONS

Because of the extremely broken topography of the survey area, with its isolated benches and steep slopes cut at frequent intervals by wide ravines, it is not practicable to draw isotherms to indicate temperature differences. However, knowing the locations of the survey stations, it should not be difficult for anyone to use the records on the ground to determine quite accurately what the relative frost hazard on any parcel of land in the district will be. Comparisons between the frost hazards at different localities can be made by referring to the tables and figures which form a part of this report, and to the topographic map. Descriptions of the locations and surrounding topography of the different stations are given on page 160.

than 2 months longer at the former station than at the latter.

Before attempting to draw even general conclusions from the data, it probably will be well to discuss very briefly the two factors mainly responsible for the development of temperature differences in the district on clear nights in spring or fall, namely air drainage and wind. By air drainage is meant the draining, down hillsides to lower levels, of surface air which has been cooled through contact with the colder ground surface. On clear, calm nights the ground surface cools rapidly after sundown through radiation of heat. This radiation passes through the air without affecting its temperature materially, and the air itself cools more slowly because of its comparatively poor radiating qualities. Air in actual contact with the ground cools through conduction; but that a few feet above the ground, or out over the valley away from the hillside, changes temperature only slightly during the night, and is almost as warm at sunrise as it was at sunset. The surface air cooled through contact with the ground becomes denser than the warm air at the same level not in contact with the ground, and tends to drain away to lower levels, and to gather in depressions in somewhat the same manner as water. However, water drainage and air drainage are quite dissimilar in some respects, and air draining from a hillside or down a canyon should not be expected to behave in all respects in the same manner as water.[1]

Although relatively cold air drains slowly down even slightly sloping ground, its movement is so sluggish that the air which replaces it cools rapidly enough, through contact with the colder ground, to make the net effect of the drainage process almost negligible. In order for air drainage to be effective in retarding the temperature drop on a clear, calm night, the slope must be greater than 150 feet to the mile, and the steeper the slope the more effective is the air drainage process. (See fig. 3, showing slope at each station.) The coldest locations, of course, are those in depressions either inclosed or with outlets so small that the cold air drains into the depression faster than it can move out.

Elevation above sea level, or above the valley floor, does not in itself have any influence on the relative degree of frost hazard in nearby locations. A depression high up on the hillside, into which the cold air can drain faster than it moves out, may be fully as cold as a similar depression at the foot of the slope on a clear, calm night. Flat or well-rounded summits of low hills practically always are colder than steep slopes below on such nights.

The second factor of importance in determining temperature differences between slope and valley floor on clear nights is wind movement. Ideal conditions for air drainage are found only when there is no general air movement in the district; and even a light wind will interfere materially, through mixing the warm air above or away from the slopes with the thin stratum of surface air which has been cooled through contact with the ground. A moderate wind may prevent stratification entirely, both on the slopes and on the valley floor, and in such cases there may be little or no difference in temperature between the hills and valleys. There usually is more wind at higher elevations than on the valley floor, and at times the wind at higher levels may cause elevated benches to be considerably warmer than areas at lower elevations, where wind may be light or entirely lacking. In such cases higher bench temperatures are due entirely to prevention of temperature stratification by the mixing effect of the wind, and not to air drainage. After stratification has developed on the valley floor on a clear, calm night, a light puff of wind may cause the temperature of the surface air to rise several degrees in a few minutes, due to mixing of the cold air near the ground with the warmer air at moderate elevations.

It will be noted that the stations listed in group 1, the favorable locations, are situated either on moderate to steep slopes, or on benches above the valley floor. (See slopes, fig. 3.) On the slopes the higher minimum temperatures are due to both air drainage and the effects of the stronger breezes at higher elevations, while the higher temperatures on the benches are due almost entirely to wind. Stations in group 2 are located at moderate elevations and on moderate to gentle slopes; and those in group 3 on slightly sloping ground, usually at the base of a steeper slope or on nearly level ground on the valley floor.

In order to contrast the topography of the area surrounding station 28, one of the coldest places, with that in the vicinity of station 5, one of the warmest, a more detailed description of the locations of these two stations is given below.

Station no. 28 was located on the floor of Badger Pocket, a depression slightly more than 6 miles long, and

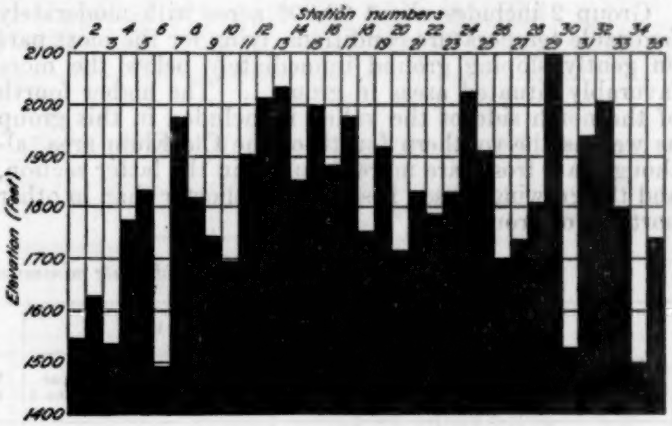


FIGURE 8.—Elevation of stations above mean sea level.

averaging about 1 mile wide, containing an irrigated area on the surrounding slopes about 4 miles wide at its mouth, narrowing to a width of about 1 mile at the upper closed end. The pocket floor slopes from southeast to northwest at the rate of from 60 to 100 feet to the mile. Extensive and comparatively steep slopes surround the pocket except at the open northwest end, where more nearly level land begins. Thus the area surrounding station 28 receives the air, cooled by nocturnal radiation, which drains from extensive slopes on three sides.

Station 5 was located in a different portion of the district, on a steep slope at a slightly higher elevation extending from south to north to much higher and lower elevations, the grade increasing considerably above, and decreasing slightly below the station location.

At times low temperatures in the survey district are the result of the general movement of cold air into the valley, accompanied by moderate to strong winds. In such cases air drainage is not a factor, and the higher slopes may be as cold as or colder than the valley floor. This condition, usually known as a freeze, seldom occurs in spring in the survey district, and the few freezes which occurred during the 5-year survey period came before crops had developed sufficiently to be damaged.

[1] W. J. Humphreys, Physics of the Air, second edition, pp. 154–157.

While it is not possible to describe in detail the relative frost hazard in every small area in the district, the following general summary may be used in conjunction with the tables and the topographic map which form a part of this report, to determine genera differences in frost hazard and length of growing season at any location within the survey area.

Of the 70,000 acres included in the survey, approximately 8,000 acres can be classed in group 1, the "favorable" locations. The Edgemont section, which lies above the 1,650-foot contour and extends eastward from Thrall to the latitude of the Wippel pumping plant, with its eastern portion narrowing under the pump lateral, and all other steep slopes on the eastern side of the valley above the 1,800-foot elevation, are included in this group. On the west and southwest sides of the district all moderately steep slopes above the west side canal also are included in group 1. The gently sloping elevated area 2 miles west of Thorp, extending southeastward, and the several benches along the river canyon in the northwest portion of the valley fall under the same favorable classification. East of Thorp and immediately across the river is an elevated area which also can be included in group 1. There is, however, a pocket in this area, the lower portion of which has only moderately favorable temperature conditions.

Group 2 includes about 22,000 acres with moderately favorable temperature conditions, lying for the most part on gently sloping ground immediately below the more favorably situated areas in group 1. The higher fourth of the north side of the valley is included in this group as well as the southern fourth of the Cle Elum area, although late frosts are more frequent in the latter section, and the growing season is somewhat shorter than in other portions of group 2.

Lands included in the temperature survey which were found to be least satisfactory from the standpoint of frost hazard and length of growing season, classed in group 3, include the lower elevations in Badger Pocket extending upward to the irrigation canals at the southeastern end of the pocket, even the highest portions having only a moderate slope. Group 3 also includes the small pocket bottom immediately east of the Milwaukee Railroad trestle across Johnson Creek Canyon. The Cle Elum area, with the exception of the higher and steeper slopes in the south quarter, has frequent late frosts, and is classed in group 3, as well as the lower portions of the north side of the district, including the Park area.

Small areas of only a few acres lying on steep slopes in the group described as unfavorable, or in pockets in the areas listed as favorable, must be excepted from the general classifications, but all of these can be picked out by inspection.

The intelligent use of the soil and temperature survey data now available for the newly irrigated portions of the valley should result in the planting of tender fruit and truck crops in the areas found to be most favorable, and the reservation of the most unfavorable portions of the district for the planting of grain and other crops requiring a relatively short growing season. The use of temperature survey data already has resulted in the selection of areas most favorable for the production of seed peas, and this new industry has shown an encouraging growth. A temperature survey of this type shows temperature differences which should continue to exist indefinitely, and the value of the data should be increasingly valuable in the years to come.

The authors wish to express their appreciation to Mr. Harold A. Rathbone, who prepared all the diagrams for this paper.

TABLE 1.—*Seasonal and 5-season absolute minimum * temperature with departures from stations nos. 2 and 3*

Station no.	1931			1932			1933			1934			1935		
	Minimum	Departure no. 2	Departure no. 3	Minimum	Departure no. 2	Departure no. 3	Minimum	Departure no. 2	Departure no. 3	Minimum	Departure no. 2	Departure no. 3	Minimum	Departure no. 2	Departure no. 3
1	21.1	−1.9	+1.7	23.7	−6.1	−0.3	20.5	−3.5	+0.5	15.0	−5.0	+1.8	10.0	−4.0	+1.0
2	23.0	0.0	+3.6	29.8	0.0	+5.8	24.0	0.0	+4.0	20.0	0.0	+6.8	14.0	0.0	+5.0
3	19.4	−3.6	0.0	24.0	−5.8	0.0	20.0	−4.0	0.0	13.2	−6.8	0.0	9.0	−5.0	0.0
4	24.3	+1.3	+4.9	30.6	+0.8	+6.6	26.0	+2.0	+6.0	24.6	+4.6	+11.4	17.0	+3.0	+8.0
5	23.3	+0.3	+3.9	30.9	+1.1	+6.9	28.8	+4.8	+8.8	24.7	+4.7	+11.5	17.5	+3.5	+8.5
6	22.7	−0.3	+3.3	27.0	−2.8	+3.0	21.0	−3.0	+1.0	15.6	−4.4	+2.4	8.9	−5.1	−0.1
7	22.0	−1.0	+2.6	29.0	−0.8	+5.0	25.8	+1.8	+5.8	26.0	+6.0	+12.8	17.8	+3.8	+8.8
8	22.0	−1.0	+2.6	29.5	−0.3	+5.5	26.0	+2.0	+6.0	24.9	+4.9	+11.7	18.0	+4.0	+9.0
9	22.1	−0.9	+2.7	26.2	−3.6	+2.2	23.0	−1.0	+3.0	20.2	+0.2	+7.0	15.3	+1.3	+6.3
10	21.3	−1.7	+1.9	28.0	−1.8	+4.0	25.0	+1.0	+5.0	21.0	+1.0	+7.8	16.0	+2.0	+7.0
11	22.0	−1.0	+2.6	28.5	−1.3	+4.5	25.5	+1.5	+5.5	22.1	+2.1	+8.9	15.0	+1.0	+6.0
12	20.0	−3.0	+0.6	27.1	−2.7	+3.1	19.6	−4.4	−0.4	----	----	----	ϕ 16.0	+2.0	+7.0
13	18.0	−5.0	−1.4	27.9	−1.9	+3.9	----	----	----	----	----	----	ϕ 16.5	+2.5	+7.5
14	24.1	+1.1	+4.7	27.0	−2.8	+3.0	26.0	+2.0	+6.0	24.0	+4.0	+10.8	16.6	+2.6	+7.6
15	‡ 19.2	−3.8	−0.2	----	----	----	----	----	----	----	----	----	ϕ 10.0	−4.0	+1.0
16	20.6	−2.4	+1.1	24.2	−4.6	+0.2	19.0	−5.0	−1.0	15.0	−5.0	+1.8	8.9	−5.1	−0.1
17	21.0	−2.0	+1.6	27.2	−2.6	+3.2	21.0	−3.0	+1.0	18.8	−1.2	+5.6	13.0	−1.0	+4.0
18	24.0	+1.0	+4.6	29.0	−0.8	+5.0	26.0	+2.0	+6.0	22.9	+2.9	+9.7	15.0	+1.0	+6.0
19	21.0	−2.0	+1.6	27.8	−2.0	+3.8	24.8	+0.8	+4.8	20.6	+0.6	+7.4	15.8	+1.8	+6.8
20	21.0	−2.0	+1.6	22.9	−6.9	−1.1	22.2	−1.8	+2.2	15.0	−5.0	+1.8	10.0	−4.0	+1.0
21	25.0	+2.0	+5.6	26.6	−3.2	+2.6	23.0	−1.0	+3.0	17.0	−3.0	+3.8	14.7	+0.7	+5.7
22	25.1	+2.1	+5.7	27.4	−2.4	+3.4	24.8	+0.8	+4.8	18.0	−2.0	+4.8	15.0	+1.0	+6.0
23	25.0	+2.0	+5.6	30.8	+1.0	+6.8	24.0	0.0	+4.0	23.6	+3.6	+10.4	18.0	+4.0	+9.0
24	22.5	−0.5	+3.1	26.5	−3.3	+2.5	22.2	−1.8	+2.2	18.9	−1.1	+5.7	10.1	−3.9	+1.1
25	19.5	−3.5	+0.1	26.0	−3.8	+2.0	21.7	−2.3	+1.7	17.5	−2.5	+4.3	6.9	−7.1	−2.1
26	‡ 23.6	+0.6	+4.2	27.0	−2.8	+3.0	23.1	−0.9	+3.1	----	----	----	ϕ 15.0	+1.0	+6.0
27	----	----	----	26.0	−3.8	+2.7	22.8	−1.2	+2.8	19.2	−0.8	+6.0	13.6	−0.4	+4.6
28	----	----	----	23.0	−6.8	−1.0	----	----	----	----	----	----	ϕ 11.0	−3.0	+2.0
29	----	----	----	28.0	−1.8	+4.0	23.2	−0.8	+3.2	24.2	+4.2	+11.0	16.5	+2.5	+7.5
30	25.0	+2.0	+5.6	28.0	−1.8	+4.0	24.0	0.0	+4.0	19.0	−1.0	+5.8	15.0	+1.0	+6.0
31	----	----	----	----	----	----	20.0	−4.0	0.0	17.0	−3.0	+3.8	11.5	−2.5	+2.5
32	----	----	----	----	----	----	19.1	−4.9	+0.9	----	----	----	ϕ 10.0	−4.0	+1.0
33	----	----	----	----	----	----	----	----	----	26.6	+6.6	+13.4	18.0	+4.0	+9.0
34	----	----	----	----	----	----	----	----	----	19.0	−1.0	+5.8	14.0	0.0	+5.0
35	----	----	----	----	----	----	----	----	----	19.0	−1.0	+5.8	14.5	+0.5	+5.5

*Absolute minimum for 5 years occurred during 1935 season.
‡ Incomplete record.
ϕ Record interpolated.

TABLE 2.—*Seasonal and 5-season average minimum temperature for all cold nights with departures from stations nos. 2 and 3*

Station no.	1931 Average	1931 Departure no. 2	1931 Departure no. 3	1932 Average	1932 Departure no. 2	1932 Departure no. 3	1933 Average	1933 Departure no. 2	1933 Departure no. 3	1934 Average	1934 Departure no. 2	1934 Departure no. 3	1935 Average	1935 Departure no. 2	1935 Departure no. 3	5-year Average	5-year Departure no. 2	5-year Departure no. 3
1	31.2	−1.8	+2.4	31.4	−2.4	+1.5	27.8	−3.9	+0.1	29.3	−3.4	+1.2	28.5	−2.9	+2.7	29.6	−2.9	+1.5
2	33.0	0.0	+4.2	33.8	0.0	+3.9	31.7	0.0	+4.0	32.7	0.0	+4.6	31.4	0.0	+5.6	32.5	0.0	+4.4
3	28.8	−4.2	0.0	29.9	−3.9	0.0	27.7	−4.0	0.0	28.1	−4.6	0.0	25.8	−5.6	0.0	28.1	−4.4	0.0
4	34.6	+1.6	+5.8	35.7	+1.9	+5.8	33.1	+1.4	+5.4	35.5	+2.8	+7.4	33.2	+1.8	+7.4	34.4	+1.9	+6.3
5	35.2	+2.2	+6.4	33.6	−0.2	+3.7	34.2	+2.4	+6.5	35.8	+3.1	+7.7	33.2	+1.8	+7.4	34.4	+1.9	+6.3
6	32.3	−0.7	+3.5	32.6	−1.2	+2.7	29.3	−2.4	+1.6	29.0	−3.7	+0.9	28.1	−3.3	+2.3	30.3	−2.2	+2.1
7	35.1	+2.1	+6.3	34.6	+0.8	+4.7	32.2	+0.5	+4.5	35.4	+2.7	+7.3	31.8	+0.4	+6.0	33.8	+1.3	+5.7
8	33.2	+0.2	+4.4	34.7	+0.9	+4.8	32.3	+0.6	+4.6	34.3	+1.6	+6.2	32.2	+0.8	+6.4	33.3	+0.8	+5.2
9	32.2	−0.8	+3.4	32.4	−1.4	+2.5	27.9	−3.8	+0.2	32.4	−0.3	+4.3	30.6	−0.8	+4.8	31.1	−1.4	+3.0
10	32.8	−0.2	+4.0	33.8	0.0	+3.9	30.6	−1.1	+2.9	33.0	+0.3	+4.9	30.7	−0.7	+4.9	32.2	−0.3	+4.1
11	33.4	+0.4	+4.6	34.0	+0.2	+4.1	31.7	0.0	+4.0	33.3	+0.6	+5.2	31.0	−0.4	+5.2	32.7	+0.2	+4.6
12	31.1	−1.9	+2.3	31.6	−2.2	+1.7	27.6	−4.1	−0.1	*29.7	−3.0	+1.6	*28.0	−3.4	+2.2	*29.6	−2.9	+1.5
13	32.1	−0.9	+3.3	33.4	−0.4	+3.5	*30.6	−1.1	+2.9	*31.7	−1.0	+3.6	*30.0	−1.4	+4.2	*31.6	−0.9	+3.5
14	33.9	+0.9	+4.1	33.5	−0.3	+3.6	31.2	−0.5	+3.5	34.1	+1.4	+6.0	31.3	−0.1	+6.5	32.8	+0.3	+4.7
15	*29.4	−3.6	+0.6	*29.7	−4.1	−0.2	*27.5	−4.2	−0.2	*28.6	−4.1	+0.5	*26.9	−4.5	+1.1	*28.4	+4.1	+0.3
16	31.5	−1.5	+2.7	31.9	−1.9	+2.0	27.5	−4.2	−0.2	28.9	−3.8	+0.8	26.4	−5.0	+0.6	29.2	−3.3	+1.1
17	31.9	−1.1	+3.1	33.6	−0.2	+3.7	29.9	−1.8	+2.2	30.5	−2.2	+2.4	29.7	−1.7	+3.9	31.1	−1.4	+3.0
18	34.0	+1.0	+5.2	34.7	+0.9	+4.8	32.4	+0.7	+4.7	33.0	+0.3	+4.9	31.6	+0.2	+5.8	33.1	+0.6	+5.0
19	31.6	−1.4	+2.8	33.4	−0.4	+3.5	31.3	−0.4	+3.6	31.6	+1.1	+3.5	28.9	−2.5	+3.1	31.4	−1.1	+3.3
20	31.1	−1.9	+2.3	31.3	−2.5	+1.4	29.8	−1.9	+2.1	28.8	−3.9	+0.7	27.4	−4.0	+1.6	29.7	−2.8	+1.6
21	31.9	−1.1	+3.1	32.2	−1.6	+2.3	30.3	−1.4	+2.6	30.2	−2.5	+2.1	28.6	−2.8	+2.8	30.6	−1.9	+2.5
22	33.6	+0.6	+4.8	34.2	+0.4	+4.3	32.7	+1.0	+5.0	31.8	−0.9	+3.7	31.2	−0.2	+5.4	32.7	+0.2	+4.6
23	35.0	+2.0	+6.2	35.2	+1.4	+5.3	32.4	+0.7	+4.7	33.7	+1.0	+5.6	32.2	+0.8	+6.4	33.7	+1.2	+5.6
24	31.5	−1.5	+2.7	32.0	−1.8	+2.1	30.5	−1.2	+2.8	29.7	−3.0	+1.6	28.6	−2.8	+2.8	30.5	−2.0	+2.4
25	29.1	−3.9	+0.3	31.2	−2.6	+1.3	28.5	−3.2	+0.8	29.3	+3.4	+1.2	27.5	−3.9	+1.7	29.1	−3.4	+1.0
26	*31.7	−1.3	+2.9	32.7	−1.1	+2.8	30.7	−1.0	+3.0	*31.5	−1.2	+3.4	*30.0	−1.4	+4.2	*31.3	−1.2	+3.2
27	*31.5	−1.5	+2.7	32.1	−1.7	+2.2	29.6	−2.1	+1.9	32.2	−0.5	+4.1	29.7	−1.7	+3.9	30.9	−1.6	+2.8
28	*29.1	−3.9	+0.3	29.4	−4.4	−0.5	*27.2	−4.5	−0.5	*28.3	−3.4	+0.2	*26.8	−4.6	+1.0	*28.2	−4.3	+0.1
29	*31.0	−2.0	+2.2	34.4	+0.6	+4.5	30.8	−0.9	+3.1	34.3	+1.6	+6.2	32.4	+1.0	+6.6	33.0	+0.5	+4.9
30	33.0	0.0	+4.2	34.2	+0.4	+4.3	31.7	0.0	+4.0	32.1	−0.6	+4.0	31.5	+0.1	+5.7	32.5	0.0	+4.4
31	*30.1	−2.9	+1.3	*30.4	−3.4	+0.5	28.2	−3.5	+0.5	30.5	−2.2	+2.4	27.6	−3.8	+1.8	*29.4	−3.1	+1.3
32	*30.0	−3.0	+1.2	*30.3	−3.5	+0.4	28.1	−3.6	+0.4	*29.2	−3.5	+1.1	*28.5	−2.9	+2.7	*29.2	−3.3	+1.1
33	*35.0	+2.0	+6.2	*35.3	+1.5	+5.4	*33.0	+1.3	+5.3	35.3	+2.6	+7.2	32.2	+0.8	+6.5	*34.2	+1.7	+6.1
34	*33.3	+0.3	+4.5	*33.7	−0.1	+3.8	*31.3	−0.4	+3.6	32.6	−0.1	+4.5	30.6	−0.8	+4.8	*32.3	−0.2	+4.2
35	*33.1	+0.1	+4.3	*33.5	−0.3	+3.6	*31.5	−0.2	+3.8	32.6	−0.1	+4.5	30.6	−0.8	+4.8	*32.3	−0.2	+4.2

* Record interpolated.

TABLE 3.—*Seasonal and 5-year frequency of temperatures 32° or lower*

Station number	5-year average	Number of days 32° or lower ocurred: 1931	1932	1933	1934	1935	5-year total
1	21	18	19	24	14	30	105
2	15	16	10	19	7	25	77
3	26	28	19	28	16	38	129
4	10	12	2	14	4	17	49
5	10	10	3	12	5	21	51
6	19	18	11	22	13	33	97
7	13	15	8	16	4	23	66
8	14	15	9	17	5	22	68
9	18	19	13	23	6	28	84
10	16	17	10	21	7	27	82
11	15	16	8	19	6	27	76
12	23	22	17	28	*16	*33	116
13	17	18	17	*11	*10	*27	83
14	16	15	13	22	5	23	78
15	26	*26	*29	*20	*19	*36	130
16	23	17	14	28	14	41	114
17	17	17	8	21	10	27	83
18	13	13	6	17	7	24	67
19	20	22	13	22	8	33	98
20	22	20	19	21	14	36	110
21	20	16	18	21	12	35	102
22	13	11	8	15	7	23	64
23	11	10	2	17	6	22	57
24	20	17	14	21	16	32	100
25	26	27	20	30	16	36	129
26	17	*17	11	20	*10	*27	85
27	17	*14	15	24	6	28	87
28	20	*20	23	*14	*13	*30	100
29	14	*17	9	19	5	20	70
30	13	14	7	17	7	21	66
31	26	*26	*29	27	11	37	130
32	29	*27	*35	29	*19	*37	147
33	13	*14	*16	*8	6	22	66
34	15	*15	*18	*9	7	26	75
35	16	*16	*19	*10	8	27	80

*Record interpolated.

TABLE 4.—*Number of hours temperature was 32° and lower by seasons*

Station number	1931 April	1931 May	1932 April	1932 May	1933 April	1933 May	1934 April	1934 May	1935 April	1935 May	Total April	Total May	Grand total	5-year average
1	69	1	-----	-----	-----	-----	-----	-----	112	7	*310	*80	390	78
2	54	0	19	0	61	6	8	1	79	1	221	8	229	46
3	98	9	59	2	98	35	19	10	144	28	418	84	502	100
4	30	0	2	0	50	0	3	0	55	0	140	0	140	28
5	20	0	2	0	46	0	3	0	62	0	133	0	133	27
6	49	1	21	1	76	17	11	9	116	6	273	34	307	61
7	38	0	18	0	61	0	7	0	70	1	194	1	195	30
8	51	0	15	0	57	0	7	0	67	2	197	2	199	40
9	68	1	35	6	70	12	13	0	-----	-----	*220	*14	234	47
10	52	0	21	0	74	10	11	0	88	3	246	13	259	52
11	40	0	23	0	66	5	13	0	85	8	227	13	240	48
12	70	5	51	4	117	34	-----	-----	-----	-----	*310	*85	395	79
13	60	2	42	1	-----	-----	-----	-----	-----	-----	*330	*90	420	84
14	52	0	-----	-----	-----	-----	10	0	81	0	*220	*7	227	45
15	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	*315	*90	405	81
16	52	6	30	8	110	28	15	13	119	33	326	92	418	84
17	49	1	13	3	77	10	8	8	94	2	241	24	265	53
18	37	0	11	0	58	2	4	0	70	0	180	2	182	36
19	57	4	20	3	71	18	9	4	107	5	164	34	198	40
20	76	0	23	2	66	14	8	5	121	3	294	24	318	64
21	35	0	22	3	63	11	8	6	92	6	220	26	246	49
22	28	0	8	0	38	4	6	1	81	0	161	5	166	33
23	29	0	3	0	47	7	4	0	86	0	169	7	176	35
24	75	0	36	6	91	5	-----	-----	-----	-----	*325	*40	365	73
25	94	9	-----	-----	-----	-----	-----	-----	-----	-----	*400	*85	485	97
26	-----	5	34	0	71	10	-----	-----	-----	-----	*220	*15	235	47
27	-----	-----	37	0	106	20	12	2	110	7	*230	*30	260	52
28	-----	-----	56	13	-----	-----	-----	-----	-----	-----	*420	*95	515	103
29	-----	-----	22	0	81	4	13	0	66	2	*170	*5	175	35
30	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	*200	*5	205	41
31	-----	-----	-----	-----	91	29	17	7	131	25	*400	*60	460	92
32	-----	-----	-----	-----	-----	-----	-----	-----	-----	-----	*400	*55	455	91
33	-----	-----	-----	-----	-----	-----	3	0	-----	-----	*135	*0	135	27
34	-----	-----	-----	-----	-----	-----	5	1	88	7	*160	*2	162	32
35	-----	-----	-----	-----	-----	-----	11	0	91	4	*190	*2	192	38

* Record interpolated.

Records for March not considered in above table.

TABLE 5.—*Number of hours temperature was 29° and lower by seasons*

Station no.	1931		1932		1933		1934		1935		Total		Grand total	5-year average
	April	May	April	May	April	May	April	May	April	May	April	May		
1	36	0	----	----	----	----	----	----	83	0	*200	*20	220	44
2	17	0	0	0	30	0	1	0	39	0	86	0	86	17
3	66	1	26	0	72	12	6	0	45	10	215	23	238	48
4	5	0	0	0	15	0	0	0	34	0	54	0	54	11
5	2	0	0	0	2	0	0	0	34	0	38	0	38	8
6	21	0	4	0	40	5	5	0	78	0	148	5	153	31
7	8	0	1	0	17	0	0	0	44	0	70	0	70	14
8	20	0	0	0	18	0	0	0	35	0	73	0	73	15
9	39	0	17	0	42	3	1	0	----	----	*110	*2	112	22
10	16	0	3	0	40	2	2	0	44	0	105	2	107	21
11	13	0	2	0	21	0	4	0	49	0	89	0	89	18
12	33	0	21	0	78	6	----	----	----	----	*208	*21	229	46
13	19	0	9	0	----	----	----	----	----	----	*200	*15	215	43
14	14	0	----	----	----	----	0	0	41	0	*103	*2	105	21
15	----	----	----	----	----	----	----	----	----	----	*210	*22	232	46
16	25	0	11	0	75	10	6	0	86	10	203	20	223	45
17	22	0	3	0	45	2	4	0	67	0	141	2	143	29
18	5	0	0	0	17	0	0	0	38	0	60	0	60	12
19	22	0	4	0	34	0	4	0	66	0	130	0	130	26
20	32	0	11	0	32	6	4	0	87	0	167	6	173	35

TABLE 5.—*Number of hours temperature was 29° and lower by seasons*—Continued

Station No.	1931		1932		1933		1934		1935		Total		Grand total	5-year average
	April	May	April	May	April	May	April	May	April	May	April	May		
21	16	0	4	0	36	0	5	0	67	0	128	0	128	26
22	10	0	2	0	9	2	5	0	51	0	77	2	79	16
23	10	0	0	0	12	1	0	0	46	0	68	1	69	14
24	40	0	6	0	35	0	----	----	----	----	*115	*4	119	24
25	64	3	----	----	----	----	----	----	----	----	*220	*25	245	49
26	----	1	5	0	34	0	----	----	----	----	*148	*5	153	31
27	----	----	11	0	52	5	4	0	56	0	*161	*2	163	33
28	----	----	34	0	0	----	----	----	----	----	*230	*30	260	52
29	----	----	2	0	51	0	2	0	38	0	*105	*0	105	21
30	----	----	----	----	----	----	----	----	----	----	*85	*0	85	17
31	----	----	----	----	64	6	10	0	84	10	*220	*20	240	48
32	----	----	----	----	----	----	----	----	----	----	*230	*30	260	52
33	----	----	----	----	----	----	0	0	----	----	*65	*0	65	13
34	----	----	----	----	----	----	2	0	46	0	*100	*1	101	20
35	----	----	----	----	----	----	0	0	46	0	*100	*1	101	20

*Record interpolated.

Records for the month of March not included in above table.

TORNADO DISASTERS IN THE SOUTHEASTERN STATES, APRIL 1936

By J. B. KINCER

[Weather Bureau, Washington, June 1936]

During the first week of April 1936, two series of disastrous tornadoes occurred in several Southeastern States, the first on April 1–2 and the second on April 5–6. In the first series tornadic storms were reported from 7 cities or towns in Georgia and the Carolinas; in the second the storms were of greater geographic extent, occurring at 17 different places scattered through 6 States, including Arkansas, Tennessee, Mississippi, Alabama, Georgia, and South Carolina. Figure 1 shows the places where tornadoes were reported and the approximate time of the several occurrences.

The atmospheric conditions responsible for these disastrous storms, as shown by the daily synoptic weather maps, are described by Louis P. Harrison, Weather Bureau, Washington, D. C., as follows:

"The two series of storms had their genesis in two different energetic depressions of rather similar nature, each characterized by V-shaped isobars with a trough extending in a south to southwesterly direction, quickly followed by an extensive anticyclone of pronounced high pressure. The tornadoes occurred in connection with the cold fronts which were associated with the troughs of these depressions and passed over the region under consideration during the periods April 1–2, and April 5–6, respectively.

"In each case the front marked the juncture of rather cold, dry, Polar Continental air, overlain in part by Polar Pacific air, advancing southeastward against warm, moist, tropical air, largely from the Gulf of Mexico. These circumstances produced conditions peculiarly favorable for the development of violent local disturbances both of the tornadic and thunderstorm variety, for there existed not only large horizontal temperature gradients across the front, but also remarkably strong vertical gradients through 2 to 5 or more kilometers in the cold-air mass."

The following accounts and descriptions of the storms are based largely on reports by the several Weather Bureau section directors of the States named:

FIRST SERIES, APRIL 1–2, 1936

In this series the first tornado was reported near Tignall, Ga., about 8:30 p. m., April 1, moving in a northeasterly direction. A number of buildings were ruined, numerous farm animals killed, and at least one person badly injured. The second is reported as occurring about 30 minutes later, at Lincolnton, Ga., some 17 miles southeast of Tignall, moving in a southeasterly direction. The telltale funnel-shaped cloud was reported, and also a rotary wind movement was evident from the position of felled trees. Reports made by the Lincolnton postmaster indicate that about 50 houses were more or less wrecked, but no satisfactory estimate of actual property loss is available. From the description of the movement and time of occurrence of the storm, and the relative geographic location of Tignall to Lincolnton, there were evidently two separate storms in this case.

The next reported occurrence was early the following morning, about 6 a. m., April 2, at Sasser, Ga. This storm moved in a northeastward direction over a path of unknown length, with destructive effects over an area from 200 to 500 yards in width; rotary wind action was evident from the position of the trees overthrown. One Negro man was killed, several people injured, and the property damage was estimated at about $3,000. The next storm, at Leesburg, Ga., about 10 miles east of Sasser, was reported to have occurred an hour later, or about 7 a. m. Here, eight people were injured and one Negro man killed; property loss was estimated at $4,300. At 7:30 a. m. of the same day, or half an hour after Leesburg was visited, an exceedingly destructive tornado occurred at Cordele, Ga., in which 23 persons were killed, nearly 500 injured, and property damaged to the amount of $3,000,000. In addition to the heavy loss of life, the property destruction here was appalling; 287 buildings were demolished, of which 100 were among the best residential homes in the city. Many of the finest houses were torn to splinters, as if blown up by great charges of dynamite.

From the locations of Sasser, Leesburg, and Cordele, and the time of tornado occurrence in each, it is quite likely that the same storm passed through these localities in succession. The time reported at Sasser, or at Leesburg, about 10 miles apart, may not have been accurately given; the first reported "about 6 a. m." and the latter "about 7 a. m."

About an hour after the Cordele disaster, or at 8:30 a. m., a tornado occurred near Lodge, Colleton County,

S. C., some 160 miles northeast of Cordele. One farmer was killed, and farm property valued at $1,000 destroyed. The movement was from the west over a path about 80 yards wide and 1 mile long.

The first series of storms came to an end at Greensboro, N. C., about 12 hours after the occurrence at Lodge, S. C., when the most destructive tornado of record in North Carolina struck that city soon after 7 p. m. on April 2. Its path was 7 miles long and varied from 50 to 800 feet in width. In its wake the casualties counted included 13 persons killed, 144 injured, and 289 buildings demolished, 56 of which were totally wrecked; property damage is estimated at $2,000,000. This storm appears to have passed a little north of Mebane at 8 p. m., and was traced in an easterly direction for 6 miles, taking the life of one person, injuring four others, and destroying $10,000 worth of property. Later (exact time unknown) there was some damage by wind 3 miles north of Hillsboro, and the last trace of the storm was reported by J. F. Hunter, cooperative observer at Arcola, Warren County, N. C., who stated "a heavy cloud and loud roar passed north of me at 9:15 p. m."

SECOND SERIES

The second family of storms began in northeastern Arkansas on the afternoon of April 5. Tornadoes were reported about 2 p. m. at Melbourne, La Crosse, and Larkin, all nearby. One person was killed at La Crosse and 4 injured; estimated property damage in the three localities was $40,000.

The next outbreak was reported from the middle Tennessee River Basin in Tennessee, in Hardin, Wayne, Lewis, and Maury Counties, or in the vicinities of Waynesboro, Hohenwald, and Columbia; the times of occurrence ranged from 7:45 to 8:30 p. m., April 5. In Hardin County one person was killed and several small buildings damaged. In Wayne County, property damage was heavier, estimated at $100,000, but no lives were lost. In Lewis County a few people were injured and property lost to the extent of $50,000, while in Maury County 5 people were killed, 20 others injured, with property loss about $50,000.

At about the time of the Tennessee tornado, or 8:05 p. m., Booneville, Miss., was visited by a similar storm, when 4 people were killed, 12 injured, and from $20,000 to $30,000 worth of property destroyed. Also, at nearly the same time, another appeared at Coffeyville, Miss., about 80 miles southwest of Booneville, at 8:10 p. m., with the loss of four lives, seven people injured, and $10,000 in property destroyed. Quickly following this, and apparently the same storm that struck Coffeyville, a very disastrous tornado occurred at Tupelo, Miss., some 60 miles to the northeast, at 8:55 p. m., causing appalling loss of life and between 3 and 4 million dollars of property destruction; 216 people were killed, and 700 injured at Tupelo and in its vicinity.

The Tupelo, Miss., tornado is reported to have occurred at 8:55 p. m., April 5, while a similar storm struck Red Bay, Ala., near the Alabama-Mississippi State line, and about 35 miles northeast of Tupelo, at 9:02 p. m. the same day. Other points in northeastern Alabama reporting tornadoes about this time were Belgreen, 9 p. m.; Rogersville, some 40 miles to the northeast, at 10:15 p. m.; and Elkwood, about 35 miles from Rogersville, and near the Tennessee line, between 10:30 and 11 p. m. It is not clear that one and the same tornado occurred at all these

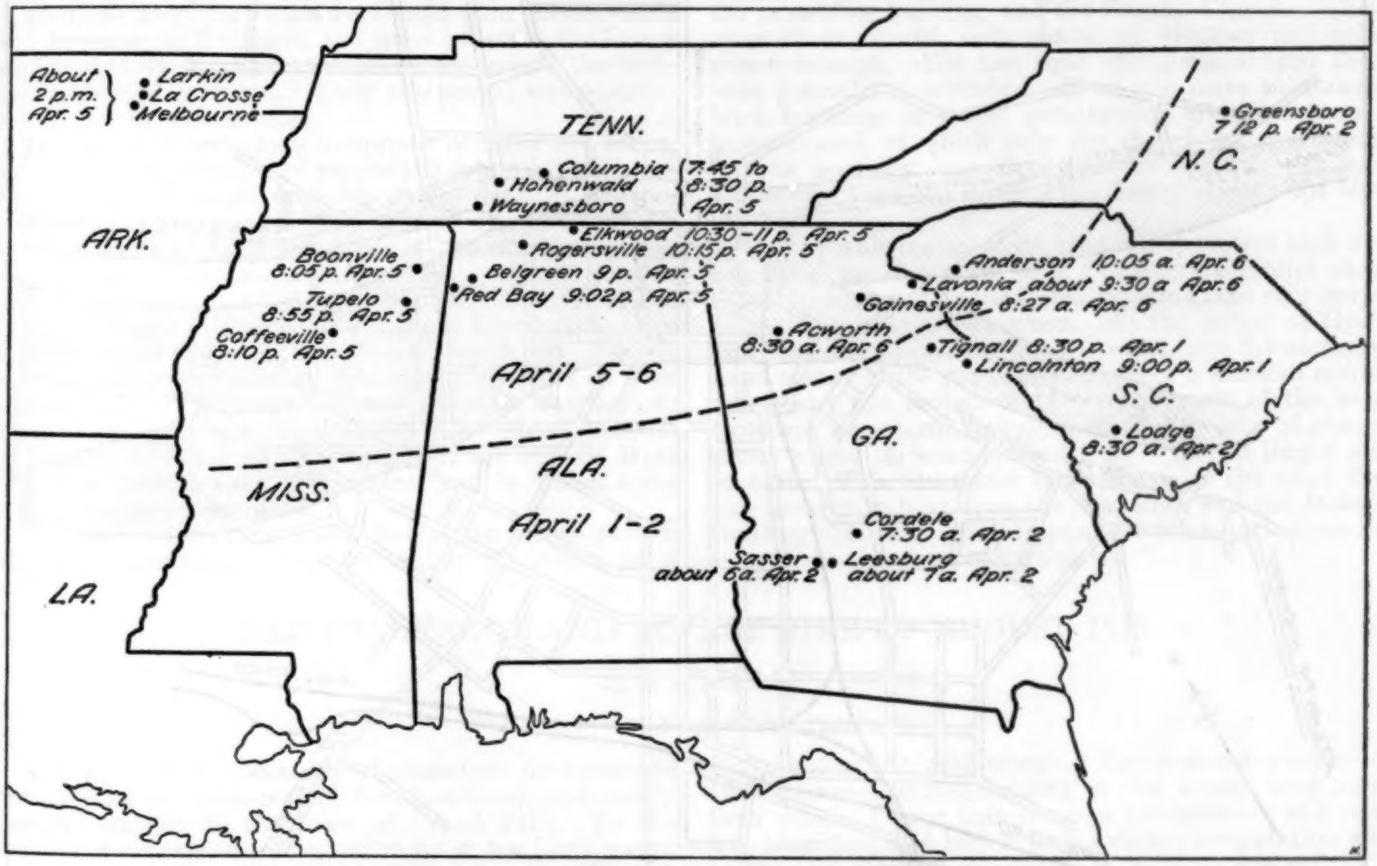


FIGURE 1.—Locations of tornadoes of April 1 and 2 and April 5 and 6, 1936.

places. There may have been more than one, but, if so, they all occurred between 9 and 11 p. m. At Red Bay, 8 persons lost their lives and 50 others were injured, while at Elkwood, 4 people were killed and 3 injured. Loss to property, in and near Red Bay, is estimated at $150,000, and at Elkwood, $5,000. Other "straight" winds were reported about this time in northeastern Alabama, especially near Tuscumbia and Florence, with property damage estimated at $7,500. One person was killed near Tuscumbia.

No tornadoes were reported between 11 p. m. on the 5th and the early morning of the 6th, when the greatest disaster of the entire series occurred in northern Georgia.

turing centers; but Gainesville, population nearly 9,000, is also the location of Brenau College for Girls and the Riverside Military Academy for Boys. The storm was attended by winds of most violent force, which utterly demolished about 750 houses and badly damaged more than 200 others, almost completely destroying the business district of the city. The loss of life reached the appalling total of 203, while 934 others were injured.

Evidence indicates that the Gainesville destruction was probably the work of three distinct tornadoes occurring almost at the same time. Relative to this aspect of the catastrophe, George W. Mindling, Section Director for Georgia, makes the following comments:

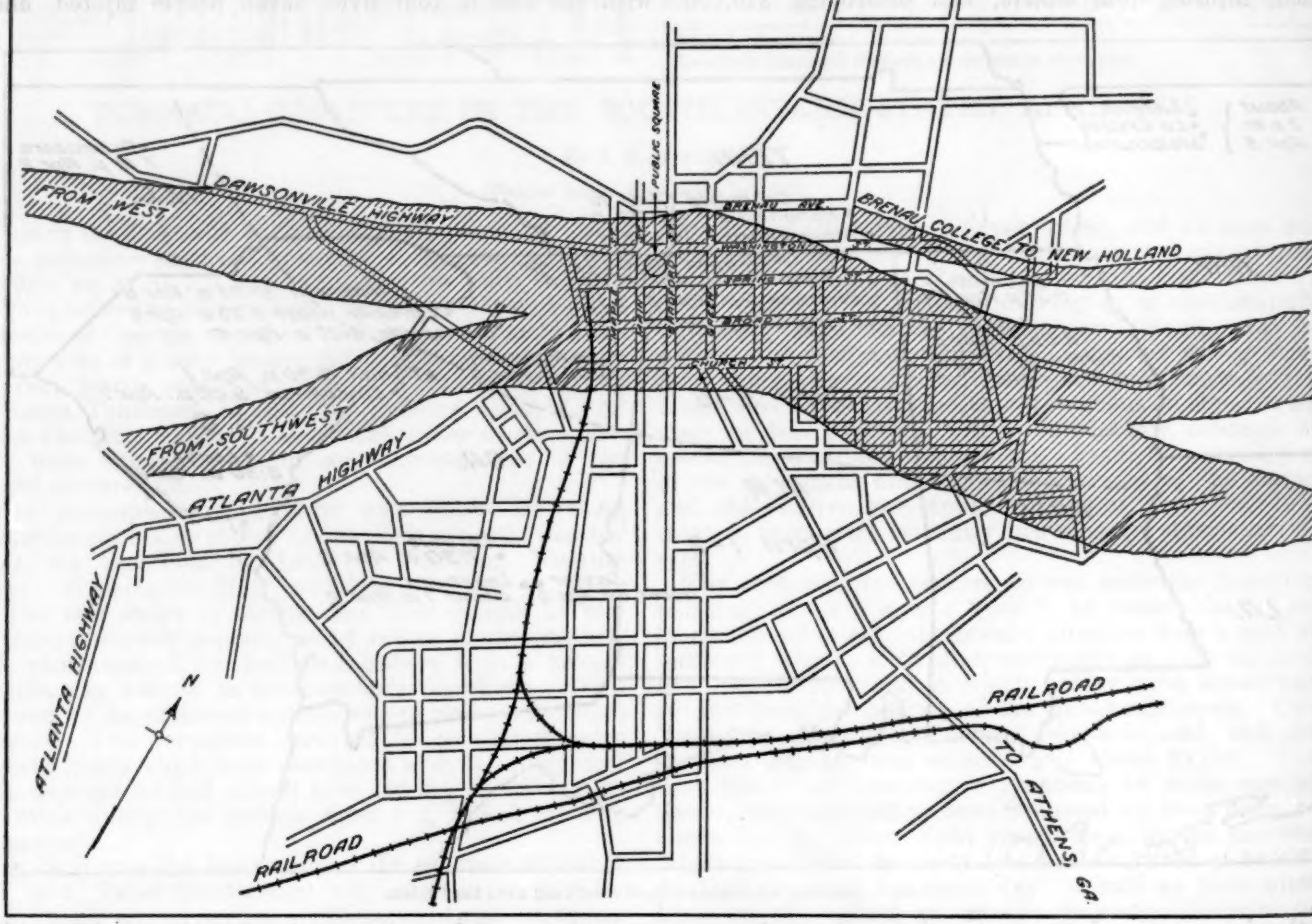


FIGURE 2.—Areas in Gainesville, Ga., devastated by tornadoes, April 1936.

About 8:30 a. m. of this date, one occurred about a mile north of Acworth, where a store, a grist mill, and two houses were completely demolished and other buildings damaged. Two women were injured. This tornado moved northeastward (in the direction of Gainesville) with a comparatively narrow path. About 8 miles east of Acworth a church and two farmhouses were destroyed. However, if the time of occurrence is correctly reported, this could not have been the same storm that caused such havoc at Gainesville, for the latter is definitely known to have occurred between 8:27 and 8:37 a. m., or approximately the same time as the Acworth disturbance, some 50 miles to the southwest. At Gainesville and New Holland one of the greatest tornadic disasters ever known in this country occurred. Both of these are manufac-

"Apparently, the first storm struck the campus of Brenau College about 8:27 a. m., the course of destruction being a narrow path extending nearly east from there through New Holland, thence northeastward into the country. The others came along 10 minutes later, two distinct funnel-shaped clouds appearing at once, as witnessed by a furniture dealer and by the mayor. These destroyed all but a few buildings in the business section. In the Western Union office, which was wrecked, the time stamps were stopped at 8:37 a. m., eastern time. One course of destruction led into the city from the southwest, just to the west of the Atlanta highway; the other came in from nearly west along the Dawsonville highway. These two paths came together west of Grove Street, and an area four blocks in width was laid waste clear across the

city, beyond which separate courses of destruction again appeared.

"Where the tornadoes finally disappeared is uncertain, but Lavonia, Ga., nearly 40 miles from Gainesville, experienced a tornado about an hour later, and Anderson, S. C., also had one on the same day. These places are nearly on a direct line east-northeast from Gainesville. However, reports of destruction at intervening points are lacking." See figure 2.

Probably the storm at Gainesville was the same one that was reported at Lavonia, Ga., about an hour later, and finally reached Anderson, S. C., nearly 70 miles northeast of Gainesville, at 10:05 a. m. If so, it traveled some 70 miles in approximately 90 minutes. Estimated damage at Lavonia was $10,000, but there was no loss of life. The width of the path at Anderson and vicinity was from 400 to 500 yards. Property damage was estimated at $250,000; about 50 homes were wrecked in the Anderson and Appleton Mill villages, and some houses in the Evans section destroyed. The tornado barely missed the business section of Anderson. Only one person was reported killed, but 30 were injured.

The group of tornadoes comprised in these two series, considering the number of people killed and injured, and the property damage, probably ranks third in destructiveness in the tornado history of the United States. In the first series of April 1–2, about 41 persons were killed and 540 injured; in the second, April 5–6, some 452 persons lost their lives and 1,775 were injured. In comparison there is a record of a series of tornadoes, supposed to have included some 60 separate storms, which occurred in several Southern States in February 1884 with an estimated loss of some 800 lives. Another outstanding tornadic disaster was the so-called "Tri-State" tornado of March 18, 1925, which occurred in the Middle West and caused more than 700 deaths, and in which some 3,000 persons were injured.

The paths of great tornadic destruction are so narrow and their occurrence so erratic that it is unusual for a locality, in the course of years, to be visited twice by such storms. However, this does happen occasionally. Two other tornadoes are known to have occurred in Gainesville, or vicinity, in past years. One of these was on March 25, 1884, destroying several houses and killing one or two persons. The other, on June 1, 1903, was much more destructive, with 98 people losing their lives; property damage was estimated at about a million dollars. In connection with the Gainesville storm, Mr. Mindling submits the following comments:

"The question has often been raised as to whether buildings of heavy, solid masonry and office buildings with strong steel framework may be expected to stand up under the full force of a violent tornado. The results at Gainesville give a good deal of assurance in favor of such structures. The city has a few such buildings, among which are the First National Bank, the Jackson Building, the post-office building, and the Baptist Church. These came through with only shattered windows and other minor damage, while less rigid structures around them were generally demolished. Even the more substantial brick buildings of recent construction crumbled around those named, of which only the church suffered much. It was partially unroofed and its interior damaged where wreckage fell in, but the heavy stone walls were not hurt.

"A very substantial stone monument 20 feet high and bearing a metal statute of a Confederate soldier came through unharmed on the Public Square at the very center of most appalling destruction. At the corner of Green and Washington Streets, just a few feet from the northernmost corner of the post-office building, a massive marble monument was broken to pieces and parts of the basal structure were carried away, including a block of granite about a foot thick and about 9 by 6 feet in length and breadth. This illustrates the violence of the wind that was brought to bear upon the post office and the Jackson Building next to it. The Baptist Church is just across the street from the wrecked monument."

THE NEWFOUNDLAND FOREST FIRE OF AUGUST 1935

By EARL B. SHAW

[State Teachers College, Worcester, Mass., February 1936]

August 13, 1935, was a day of misfortune for owners of timber land in north-central Newfoundland, and nearly brought tragedy to the town of Grand Falls. To the student of climate, the fire, which in a few days swept many square miles of forest, offers an interesting illustration of the importance of weather conditions for conflagrations. The writer, who was in Grand Falls during the middle of August, became greatly interested in the atmospheric relationships that were evident throughout the catastrophe. Personal observations and data furnished by residents of Grand Falls upon weather and daily progress of the fire, have made possible the following study of the relation of meteorological conditions to the start, expansion, and final extinction of the blaze.

Summer is the season of greatest fire danger in the timber-covered island of Newfoundland. At this period of the year, insolation not only removes the protecting blanket of winter snow, but also warms the air and lowers the relative humidity. The result is a dry forest bed and a dry atmosphere which make the fire hazard far greater than that of the cold season. The summer weather of 1935 increased inflammability in the forests even more than usual. Lower than average precipitation and relative humidity, and higher than average temperature and barometric pressure combined to produce exceptionally favorable conditions for fires.

Although the total precipitation for the first 7 months of the year was 3.88 inches [1] above normal (27.37 inches compared with a normal of 23.49 inches), the amount for June and July was 1.4 inches below normal (5.5 inches compared with a normal of 6.9 inches); and during the first part of August little more than a trace of rain fell. Moreover, the number of rainy days in June and July was the lowest on record, seven below normal.

[1] Official long time climatic data are exceedingly difficult to obtain in Newfoundland. Few official stations have a comprehensive record over a number of years. There is no Government weather observer in Grand Falls, but the statistics used in this article were furnished by a local firm that has kept careful records on certain climatic elements for 8 years. The writer checked these records with those which he procured from the Buchans Mining Co. at Buchans, a mining town approximately 50 miles to the southwest, and a close correlation was evident in most cases. The latter company has recorded weather data for a period of 5 years.

The following table indicates the extent to which summer temperatures of 1935 were above normal:

TABLE 1

	8 years	1935
	°F.	°F.
Mean temperature:		
June, July, and August	59.3	61
June	54.2	58.2
July	62.6	62
August	61.1	62.9
Mean maximum temperature:		
June, July, August	83.2	86
June	81.9	82
July	85.4	85
August	82.4	91

Students of forest fires consider high barometric pressures to be a contributing climatic element in fire weather; figures listed below show that the 1935 readings were markedly high:

TABLE 2

	8 years	Same period 1935
	Inches	Inches
Mean barometric pressure:		
First 8 months of year	29.67	29.77
June, July, and August	29.70	29.93
August	29.79	29.93
10-day fire period		29.99

The writer was unable to obtain any data on relative humidity for Grand Falls or for Buchans, except for the period of the fire, and these show only the minimum readings. However, 5-year records were obtained from Corner Brook, the other paper manufacturing town in Newfoundland. This station is situated near the west coast, a location giving it a higher relative humidity than that for the inland city of Grand Falls. Nevertheless as the trends of other climatic elements are similar between the two stations, the relative humidity should show some correlation. The figures for June and July 1935 in Corner Brook show a mean relative humidity of 2.3 percent below the 5-year normal.

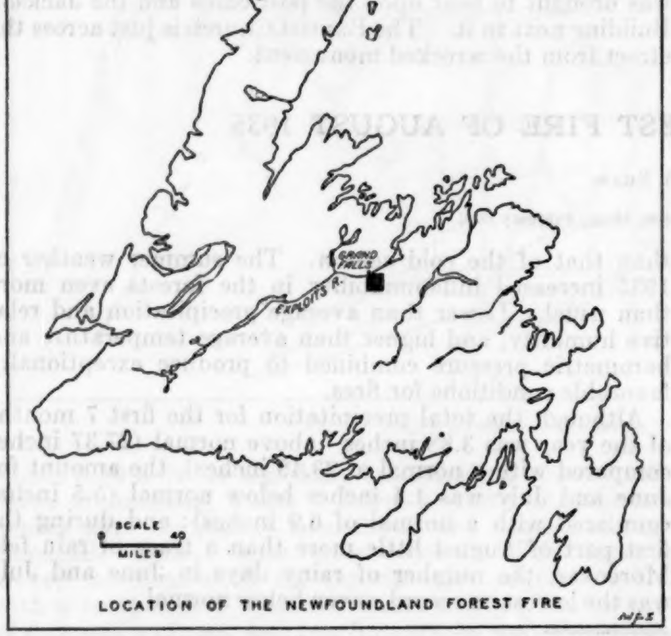


FIGURE 1. Location of the Newfoundland forest fire, August 1935. The fire started between the headwaters of two small streams, Stony Brook and Little Battling Brook, approximately 10 miles from Grand Falls.

High winds always favor the development of a forest fire. Although statistics were unobtainable except for the period of the fire, several residents of Grand Falls assured the writer that wind velocities during June, July, and the first part of August were above normal.

One may conclude from a study of the conditions during the period preceding the August fire, that critical meteorological elements were favorble for the blaze. Moreover, once the fire was started, a continued lack of rainfall, low relative humidity, high temperatures, and high winds all united to hinder control.

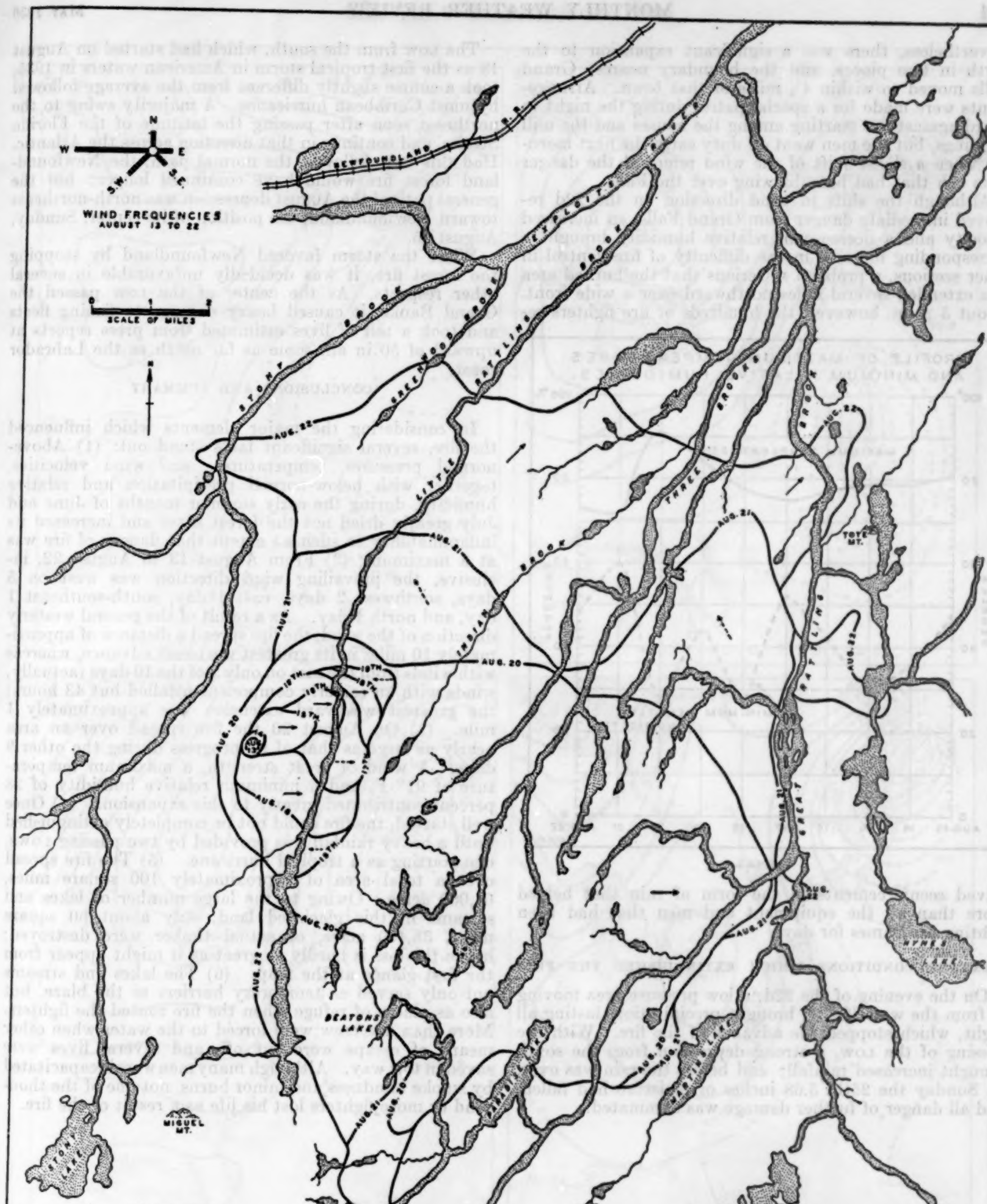
WEATHER CONDITIONS DURING THE FIRE

The fire was discovered near the headwaters of Stony Brook (figs. 1 and 2), approximately 10 miles south of Grand Falls, on the afternoon of August 13; immediately an organized attempt to stop it began, as a crew of 10 men, well equipped for fire fighting, started toward Stony Brook. These were reenforced by 10 more on the 14th; and on the morning of the 15th, control appeared possible. The wind had been light on the 13th and 14th, and had it remained light during the 15th, the fire undoubtedly would have been put out by those in charge—surely with the aid of the additional crew who early on the 15th were on their way from Grand Falls to the fire region; but instead, by 2 p. m. of the 15th, the wind velocity had increased to such a degree that all hope of limiting the fire, without the aid of a heavy downpour of rain, was lost.

A downpour did not come until the night of August 22, and in the meantime hundreds of men (newspaper reports indicate as many as 1,200 at one time) were sent to fight the fire. From the afternoon of the 15th until the 19th the fire crews were forced back in a general easterly direction before the prevailing westerly wind (fig. 2). On 3 of the 4 days, August 15 to 19, the wind was fresh; but in spite of the breeze the men gave way quite gradually and kept the blaze confined within less than one-fifth of the area which it gained so easily on the 20th when fanned by a strong wind from the west (fig. 2). On the 19th the direction shifted from west to east, velocity declined from fresh to light, and a slowly falling rain gave real hope of relief. These conditions were short lived. The total precipitation amounted to but 0.015 inch, and the morning of the 20th brought the strong westerly wind mentioned above. Moreover, the minimum relative humidity, which had averaged 40 percent for the previous 7 days (a relative humidity of 50 percent is considered dangerous in the timber regions along the northwest coast of the United States[2]) dropped to 28 percent (fig. 3), that afternoon. To complete the weather conditions favorable for the spread of a fire, the temperature rose to 91° F. In response to this ideal fire weather, the blaze expanded tremendously, with seven times the spread for any previous 24-hour period. The 20th of August 1935, will long be remembered at Grand Falls. Toward evening huge cumulus clouds arose over the fire area, only a few miles away.

By the 21st the strong wind had died down; and a light breeze from the south-southeast, with an increase in minimum relative humidity from 28 to 60 percent, made fire fighting less difficult than on the previous day.

[2] Dague, Charles I. Disastrous Fire Weather of September 1929, *Bulletin of the American Meteorological Society*, vol. XI, no. 12, December 1930, p. 215.



PROGRESS OF FIRE AUGUST 13 - 22, 1935.

FIGURE 2.

Nevertheless, there was a significant expansion to the north in two places, and the boundary nearest Grand Falls moved to within 4½ miles of that town. Arrangements were made for a special patrol during the night to guard against fire starting among the houses and the mill buildings, but the men went off duty early the next morning when a slight shift of the wind removed the danger from ash that had been blowing over the Falls.

Although the shift in wind direction on the 22d removed immediate danger from Grand Falls, an increased velocity and a decrease in relative humidity brought a corresponding increase in the difficulty of fire control in other sections, a problem so serious that the burned area was extended several miles northward over a wide front. About 5 p. m. however, the hundreds of fire fighters received reenforcements in the form of rain that helped more than all the equipment and men that had been fighting the flames for days.

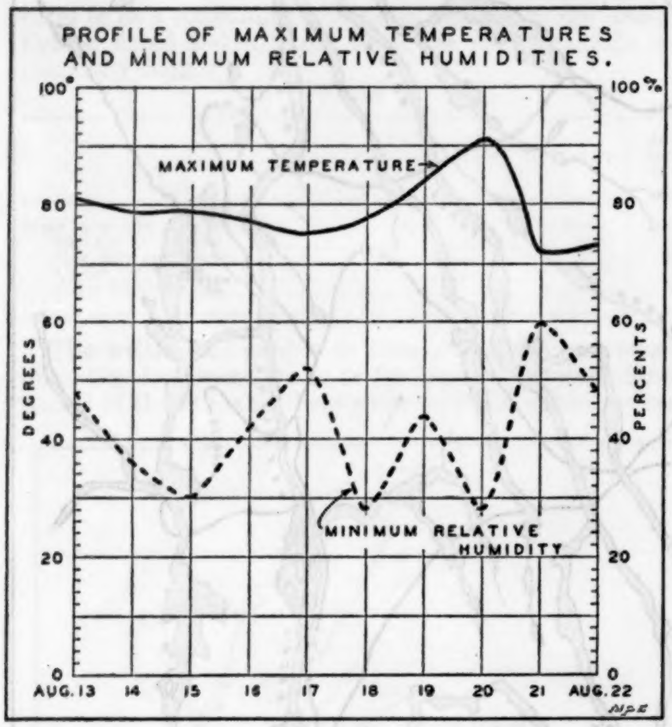


FIGURE 3.

WEATHER CONDITIONS WHICH EXTINGUISHED THE FIRE

On the evening of the 22d, a low pressure area moving in from the west (fig. 4) brought precipitation, lasting all night, which stopped the advance of the fire. With the passing of the LOW, a strong depression from the south brought increased rainfall; and before the rain was over, on Sunday the 25th, 5.08 inches of moisture had fallen, and all danger of further damage was eliminated.

The LOW from the south, which had started on August 18 as the first tropical storm in American waters in 1935, took a course slightly different from the average followed by most Caribbean hurricanes. A majority swing to the northeast soon after passing the latitude of the Florida Straits, and continue in that direction across the Atlantic. Had this LOW followed the normal path, the Newfoundland forest fire would have continued longer; but the general path of the August depression was north-northeast toward Newfoundland, the position of its center, Sunday, August 25.

While the storm favored Newfoundland by stopping the forest fire, it was decidedly unfavorable in several other respects. As the center of the LOW passed the Grand Banks, it caused heavy damage to fishing fleets and took a toll of lives estimated from press reports at upward of 50 in all, some as far north as the Labrador coast.

CONCLUSIONS AND SUMMARY

In considering the major elements which influenced the fire, several significant facts stand out: (1) Above-normal pressures, temperatures, and wind velocities, together with below-normal precipitation and relative humidity, during the early summer months of June and July greatly dried out the forest litter and increased its inflammability to such an extent that danger of fire was at a maximum; (2) From August 13 to August 22, inclusive, the prevailing wind direction was west on 5 days, southwest 2 days, east 1 day, south-southeast 1 day, and north 1 day. As a result of the general westerly direction of the wind, the fire spread a distance of approximately 10 miles in its greatest west-east advance, whereas with winds from the east on only 2 of the 10 days (actually, winds with an easterly component totalled but 43 hours) the greatest westward extension was approximately 1 mile. (3) On August 20 the fire spread over an area nearly as large as that of its progress during the other 9 days. A wind of great strength, a maximum temperature of 91° F, and a minimum relative humidity of 28 percent contributed greatly to this expansion. (4) Once well started, the fire could not be completely extinguished until a heavy rainfall was provided by two passing LOWS, one starting as a tropical hurricane. (5) The fire spread over a total area of approximately 100 square miles, 64,000 acres. Owing to the large number of lakes and streams in this glaciated land, only about 60 square miles, 38,400 acres, of actual timber were destroyed; hence the loss is hardly as great as it might appear from the first glance at the map. (6) The lakes and streams not only served as temporary barriers to the blaze, but also as places of refuge when the fire routed the fighters. More than one crew were forced to the water when other means of escape were cut off, and several lives were saved in this way. Although many men were incapacitated by smoke blindness and minor burns, not one of the thousand or more fighters lost his life as a result of the fire.

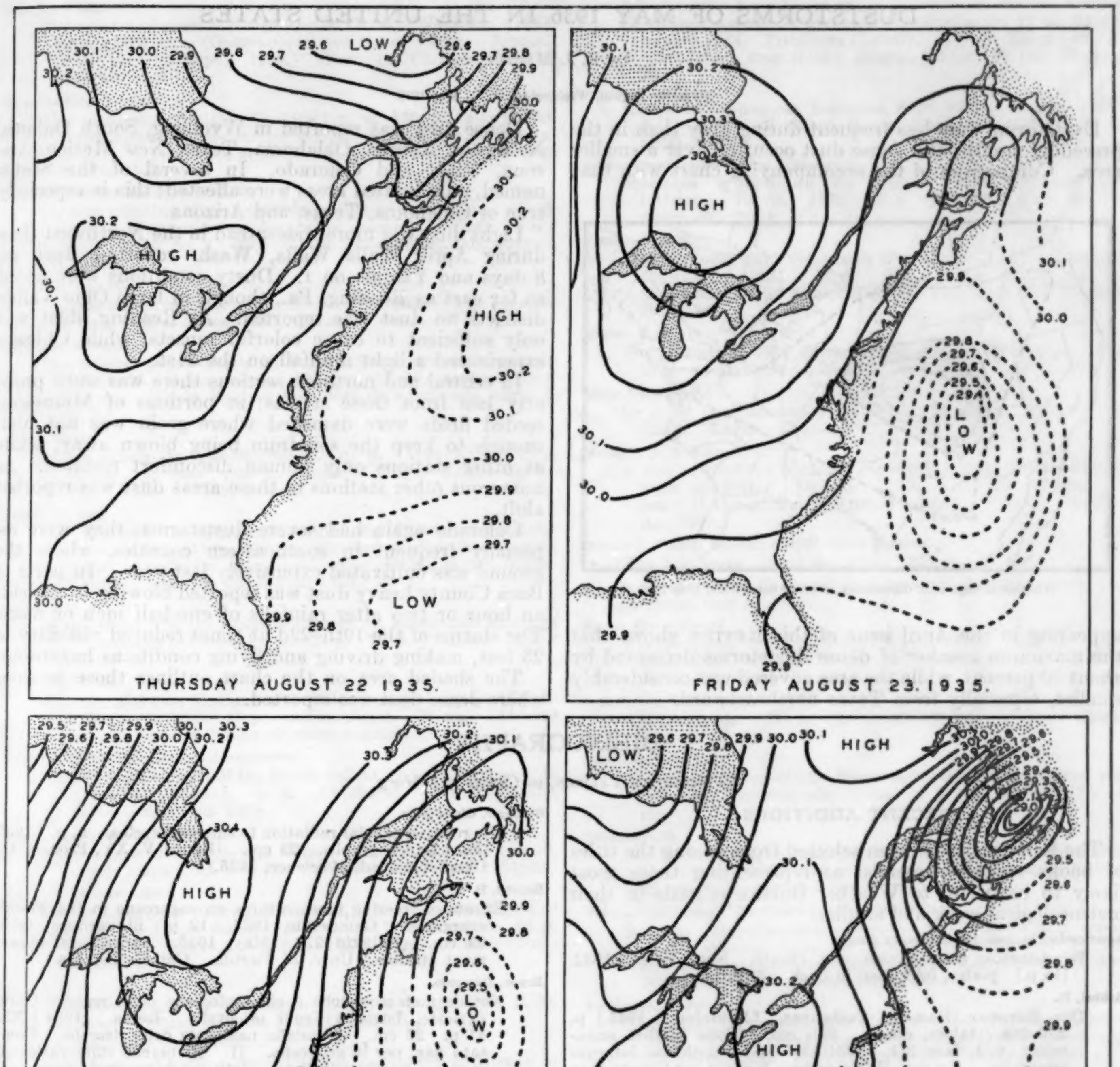


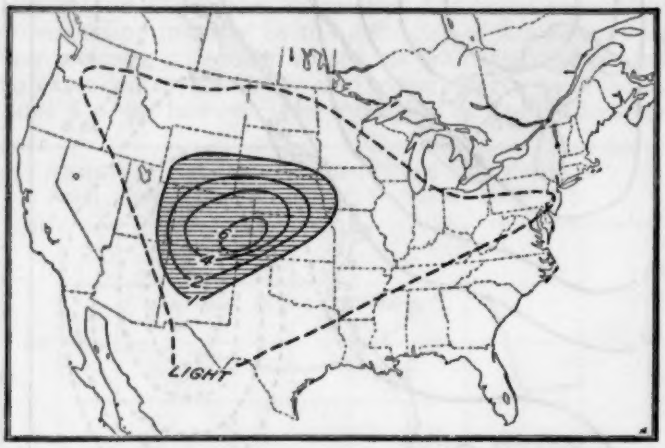
FIGURE 4. Movement of storms bringing rain to Newfoundland. On the 22d a low pressure area of medium intensity brought rain which started to drench the forest fire. The deluge which completed the task came with a storm that began its course as a tropical hurricane on the 18th of August. A complete chart of the storm movement and a detailed description of the depression may be found in the MONTHLY WEATHER REVIEW for August 1935.

DUSTSTORMS OF MAY 1936 IN THE UNITED STATES

By R. J. MARTIN

[Weather Bureau, Washington, D. C., May 1936]

Duststorms were less frequent during May than in the preceding month, and dense dust occurred over a smaller area. Comparison of the accompanying chart with that



Number of days with duststorms, or dusty conditions, May 1936.

appearing in the April issue of this REVIEW shows that the maximum number of dense duststorms decreased by about 50 percent, while the area covered was considerably smaller, especially from Texas northeastward.

Dense dust was reported in Wyoming, South Dakota, Nebraska, Kansas, Oklahoma, Texas, New Mexico, Arizona, Utah, and Colorado. In several of the States named, only limited areas were affected; this is especially true of Oklahoma, Texas, and Arizona.

Light dust was more widespread in the Northwest than during April; Walla Walla, Wash. reported dust on 8 days and Yakima on 1. Dusty conditions were noted as far east as Reading, Pa., though in large Ohio Valley districts no dust was reported. At Reading, dust was only sufficient to cause colorful sunsets, while Chicago experienced a light mudfall on the 31st.

In central and northern sections there was some property loss from these storms; in portions of Minnesota seeded fields were damaged where grain was not high enough to keep the soil from being blown away, while at other stations only human discomfort resulted. At numerous other stations in these areas dust was reported aloft.

Colorado again had severe duststorms; they were especially frequent in southeastern counties, where the ground was cultivated extensively last year. In parts of Baca County heavy dust was reported blowing from fields an hour or two after rainfalls of one-half inch or more. The storms of the 19th–22d at times reduced visibility to 25 feet, making driving and flying conditions hazardous.

The shaded area on the chart outlines those sections where dense dust was reported.

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SOLAR OBSERVATIONS

SOLAR RADIATION OBSERVATIONS DURING MAY 1936

By IRVING F. HAND, *Assistant in Solar Radiation Investigations*

For a description of instruments employed and their exposures, the reader is referred to the January 1935 REVIEW, page 24.

Table 1 shows that solar radiation intensities averaged above normal at Washington and Madison, and below normal at Lincoln. No water-vapor clouds were detected on May 15 at Lincoln when the exceedingly low radiation values were obtained. White haze was reported at the station when readings were made; and W. J. Bryan of the university station reports that notes from cooperative observers near Lincoln indicate severe local dust storms, chiefly at high elevation. Several other dust-storms were reported near Lincoln during the month, with resulting effects on the solar radiation receipt, as shown in table 1.

Table 2 shows a very marked excess in the amount of total solar and sky radiation at all stations, with the exception of Fairbanks, Twin Falls, Miami, Blue Hill, Friday Harbor, and Ithaca.

Polarization observations obtained at Washington on 5 days give a mean of 61 percent, with a maximum of 63 percent on the 28th. At Madison, observations made on 7 days give a mean of 60 percent, with a maximum of 67 percent on the 27th. All of these values are slightly higher than the corresponding May normals.

TABLE 1.—*Solar radiation intensities during May, 1936*

[Gram-calories per minute per square centimeter of normal surface]

WASHINGTON, D. C.

Date	Sun's zenith distance										
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e
	mm	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm
May 1	10.59	0.58	0.67	0.82	0.96	1.39	0.94				10.21
May 5	6.27					1.43					5.79
May 6	6.27	.57	.71	.86	1.09	1.39					6.27
May 14	4.95	.81	.93	1.05	1.22	1.45	1.12				4.97
May 15	7.04	.60	.75	.94	1.09	1.42	1.22				4.75
May 20	5.56	.78	.89	1.05	1.22	1.42	1.18				4.75
May 22	8.18						.98				5.36
May 23	8.18				1.16	1.36					7.29
May 28	5.33	.56	.72	.97	1.32	1.14					4.57
May 29	4.95				1.23	1.42					4.75
Means		.65	.78	.95	1.16	1.41	1.09				
Departures		+.02	+.06	+.12	+.16	+.14	+.16				

TABLE 1.—*Solar radiation intensities during May, 1936*—Contd.

MADISON, WIS.

Date	Sun's zenith distance										
	8 a. m.	78.7°	75.7°	70.7°	60.0°	0.0°	60.0°	70.7°	75.7°	78.7°	Noon
	75th mer. time	Air mass									Local mean solar time
		A. M.					P. M.				
	e	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e
	mm	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	mm
May 5	7.87			0.72	0.89						9.83
May 8	10.97				.99						12.24
May 13	6.50					1.52					5.56
May 14	4.75		0.89	1.01	1.20	1.39					5.56
May 19	8.18		.59	.76	1.16	1.51					6.76
May 21	7.04		.77	.88							6.27
May 25	8.48					1.36					7.87
May 26	10.21			.92	1.12						10.97
May 27	11.38				1.27	1.49					8.48
May 28	5.36		.77	.91	1.10	1.54					7.04
May 29	6.50		1.04	1.14	1.27	1.49					6.50
Means			.81	.91	1.12	1.47					
Departures			−.01	.00	+.01	+.10					

LINCOLN, NEBR.

Date	e	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e
May 4	9.83					1.36	1.06	0.88	0.70	0.50	10.59
May 12	10.97						1.20	1.00	.86	.73	11.38
May 13	6.76		.86	1.02	1.19	1.43					5.16
May 14	7.04							.92	.78	.67	6.27
May 15	9.47		.24	.36	.59		1.11	.90	.77	.63	12.24
May 16	13.13				.61	1.20					12.24
May 18	7.29							1.04	.89	.78	6.76
May 19	7.87		.87	1.01	1.22	1.39	1.10	.93	.79	.66	7.57
May 26	11.81		.95	1.12	1.26	1.42					12.24
May 27	9.83			.98	1.14	1.42					11.38
May 28	8.81				1.24	1.45					8.18
Means			.73	.90	1.04	1.38	1.12	.94	.80	.66	
Departures			−.05	−.03	−.07	.00	+.02	+.04	−.01	−.02	

BLUE HILL, MASS. (HARVARD UNIVERSITY)

Date	e	5.0	4.0	3.0	2.0	1.0	2.0	3.0	4.0	5.0	e
May 1	10.7				0.71	1.10					12.3
May 2	10.7				1.14	1.50	1.08	.74			11.9
Mya 5	6.5			1.23	1.34	1.46					2.9
May 6	5.6				.96	1.18					6.5
May 7	8.8					1.08	.95				7.6
May 8	10.5			.71	.77	1.16					11.9
May 9	11.5				.76	1.12	.99				11.5
May 10	6.5					1.25	.91				7.4
May 11	8.6				.84	1.16	.75				11.9
May 14	6.5					1.45	1.18				4.6
May 15	5.6	1.04	1.11	1.21	1.35	1.50					3.8
May 16	2.3				1.34	1.53	1.34	1.21	1.15	1.09	3.0
May 17	6.5					1.25	1.04				8.6
May 18	13.2				.83	1.20					9.6
May 19	13.2				1.11	1.07					14.3
May 20	5.0				1.17	1.47	1.21				4.8
May 21	5.6			1.21	1.43						3.8
May 22	4.4			1.15	1.24	1.46	1.02				3.3
May 23	7.4				1.01	1.28					7.4
May 24	12.8				.75	1.15					13.3
May 25	9.2				1.28	1.38					8.6
May 26	6.5				1.10	1.37	1.06				8.2
May 27	9.9							.85	.75	.66	11.1
May 28	6.8			1.04	1.18						6.5
May 29	6.3				.86	1.39					6.8
May 30	7.6				.88	1.44					6.8
May 31	6.5				1.25	1.45					6.3
Means		1.04	1.11	1.09	1.05	1.31	1.05	.93	.95	.88	

TABLE 2.—*Average daily totals of solar radiation (direct+diffuse) received on a horizontal surface*

Week beginning—	Washington	Madison	Lincoln	Chicago	New York	Fresno	Pittsburgh	Fairbanks	Twin Falls	La Jolla	Miami	New Orleans	Riverside	Blue Hill	Mount Washington	Friday Harbor	Ithaca	San Juan
	Gram-calories per square centimeter																	
1936	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.	cal.
Apr. 29	559	350	493	323	412	686	393	391	416	616	520	609	559	425	....	712	345	485
May 6	544	473	330	458	528	709	566	459	640	630	555	486	627	506	....	563	534	389
May 13	548	593	647	615	538	749	580	434	613	666	424	360	588	571	....	533	359	413
May 20	650	507	521	501	683	739	656	476	634	461	450	341	555	702	....	560	450	411
May 27	661	546	686	592	563	629	556	345	471	685	393	567	540	546	....	210	302	555
	Departures from weekly normals																	
Apr. 29	+103	−88	+18	−48	+23	+60	....	−10	−97	....	−5	+228	−1	−61	....	+163	−53	....
May 6	+97	+29	−114	+75	+139	+67	....	+42	+50	....	+21	+104	+75	+9	....	+13	+83	....
May 13	+77	+111	+124	+82	+118	+82	....	−10	−10	....	−66	−5	+28	+23	....	+17	−148	....
May 20	+143	+15	−36	+143	+237	+63	....	+34	−10	....	−47	−46	−13	+128	....	+81	−57	....
May 27	+137	+49	+166	+131	+202	−47	....	−57	−109	....	−79	+73	−20	+26	....	−290	−134	....
	Accumulated departures on June 2																	
	+1,764	+1,484	+819	+4,851	+4,984	+3,339	....	+35	+336	....	−2,821	+6,825	−343	−42	....	+793	−2,629	....

TABLE 3.—*Total, I_m and screened, I_y, I_r, solar radiation intensity measurements, obtained during May 1936 and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*

AMERICAN UNIVERSITY, WASHINGTON, D. C.

Date and hour angle, 1936	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{w-r}}{1.94}$ Percentage of solar constant	$\frac{I_{w-r}-I_m}{1.94}$ Percentage of solar constant	w	Air-mass type
May 1	° ′	m	gr. cal.	gr. cal.	gr. cal.						mm	
1:28 p. m.	59 21	1.16	1.311	0.928	0.719	0.068	0.020	0.044	83.6	15.2	50.0	T_c
1:32 p. m.	58 47	1.17	1.308	.926	.713	.068	.020	.044	83.6	15.4	50.0	
May 14												
1:12 p. m.	64 29	1.11	1.432	.958	.753	.037	.028	.032	85.2	10.1	12.0	P_c
1:16 p. m.	63 27	1.12	1.427	.956	.750	.037	.027	.032	85.2	10.3	12.1	
May 15												
0:36 a. m.	68 34	1.07	1.338	.943	.743	.110	.050	.080	79.2	9.0	11.6	N_{pc}
0:32 a. m.	68 52	1.07	1.339	.944	.744	.110	.050	.080	79.2	8.9	11.7	
May 20												
1:20 a. m.	64 27	1.11	1.357	.958	.747	.086	.022	.054	82.8	10.4	16.0	P_c
1:16 a. m.	65 01	1.10	1.360	.958	.747	.085	.021	.053	82.8	10.4	15.8	
May 28												
2:52 a. m.	49 27	1.31	1.418	.943	.751	.034	.040	.037	82.9	8.1	6.1	P_c
2:44 a. m.	50 09	1.30	1.419	.943	.7.1	.036	.040	.038	82.9	8.1	6.4	

ATMOSPHERIC CONDITIONS DURING TURBIDITY MEASUREMENTS

May 1. Temperature 20° C., wind, SE 10; visibility, 30 miles; blueness of sky, 4; polarisation, 59.8 percent.
May 14. Temperature 10° C., wind, NW. 18; visibility, 30 miles; blueness of sky, 6; polarisation, 61.6 percent.
May 15. Temperature 9° C., wind, SE. 8; visibility, 30 miles; blueness of sky, 5; polarisation, 60.7 percent.
May 20. Temperature 12° C., wind, NW. 16; visibility, 30 miles, blueness of sky, 5; polarisation, 60.5 percent.
May 28. Temperature 11° C., wind, NW. 20; visibility, 50 miles; blueness of sky, 6; polarisation, 62.9 percent.

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY

Date and hour angle, 1936	Solar altitude	Air mass	I_m	I_y	I_r	$\beta_{I_{m-r}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_m-0}{1.94}$ Percentage of solar constant	$\frac{I_m-0-I_m}{1.94}$ Percentage of solar constant	w	Air-mass type
May 1	° ′	m	gr. cal.	gr. cal.	gr. cal.						mm	
3:12 a. m.	40 42	1.53	0.879	0.619	0.515	0.204	0.208	0.206	56.3	10.3	6.1	T_c
May 2												
2:59 a. m.	43 31	1.45	1.283	.829	.644	.033	.050	.042	86.0	13.8	11.3	T_c, S aloft.
4:04 p. m.	24 16	2.43	.990	.699	.550	.060	.062	.061	67.8	15.4	9.6	
May 5												
2:47 a. m.	44 53	1.41	1.236	.812	.651	.076	.107	.92	73.4	8.6	6.9	N_{pc}
1:40 a. m.	55 43	1.21	1.400	.919	.720	.022	.043	.032	85.0	10.5	9.4	
May 6												
3:16 a. m.	41 00	1.52	1.085	.762	.608	.123	.108	.116	68.6	11.8	9.4	N_{pc}
0:32 a. m.	63 05	1.12	1.159	.798	.631	.149	.145	.147	71.1	10.5	9.7	

TABLE 3.—*Total, I_m and screened, I_y I_r, solar radiation intensity measurements, obtained during May 1936 and determinations of the atmospheric turbidity factor, β, and water-vapor content, w=depth in millimeters, if precipitated*—Continued

BLUE HILL METEOROLOGICAL OBSERVATORY OF HARVARD UNIVERSITY—Continued

Date and hour angle, 1936	Solar altitude		Air mass	I_m	I_y	I_r	$\beta_{I_{m-y}}$	$\beta_{I_{y-r}}$	β_{mean}	$\frac{I_{w-o}}{1.94}$ (Percentage of solar constant)	$\frac{I_{w-o}-I_m}{1.94}$ (Percentage of solar constant)	w	Air-mass type
	°	′	m	gr. cal.	gr. cal.	gr. cal.						mm	
May 7													
3:48 p. m.	35	24	1.72	1.024	0.720	0.569	0.110	0.112	0.111	66.5	12.7	9.1	$N_{PC} \rightarrow T_G$.
4:36 p. m.	26	34	2.23	.846	.605	.501	.120	.143	.132	56.8	12.4	8.1	
May 8													
4:08 a. m.	31	55	1.89	.818	.565	.446	.112	.130	.121	61.2	18.2	13.0	T_G.
2:17 a. m.	51	25	1.28	1.065	.707	.561	.118	.128	.123	71.3	15.3	13.3	
0:08 a. m.	64	43	1.10	1.131	.727	.584	.128	.137	.132	74.5	15.1	14.1	
3:50 p. m.	34	29	1.77	.872	.615	.496	.160	.150	.155	65.0	19.4	14.4	
May 9													
2:32 a. m.	49	10	1.32	1.081	.720	.561	.110	.117	.114	71.8	15.0	12.8	T_G.
1:40 p. m.	56	37	1.19	1.203	.802	.632	.096	.107	.102	72.9	9.7	8.6	
May 10													
2:54 p. m.	45	26	1.40	1.142	.755	.618	.102	----------	.102	71.0	11.0	9.1	P_A.
4:16 p. m.	30	47	1.95	.923	.683	.537	.126	.106	.116	62.6	14.1	9.8	
May 11													
3:12 a. m.	42	38	1.48	.992	.678	.566	.163	.225	.194	59.5	7.3	7.0	$N_{PM} \rightarrow T_A$.
1:02 a. m.	62	15	1.27	1.092	.741	.613	.157	.201	.179	63.4	6.0	5.0	
0:43 p. m.	64	36	1.23	1.086	.725	.606	.143	.250	.196	63.4	7.7	6.7	
3:25 p. m.	40	16	1.54	.929	.645	.537	.142	.175	.158	53.3	4.4	3.3	
May 14													
0:31 a. m.	65	27	1.10	1.412	.902	.735	.044	----------	.044	81.0	6.6	6.0	N_{PC}, T_G aloft.
3:39 p. m.	38	14	1.61	1.260	.854	.681	.058	.064	.058	76.3	10.2	7.8	
May 15													
4:29 a. m.	29	07	2.06	1.337	.894	.734	.024	.062	.043	71.4	3.9	2.5	N_{PC}.
3:03 a. m.	44	51	1.41	1.452	.942	.766	.018	.080	.049	81.8	5.3	4.3	
0:16 a. m.	66	18	1.09	1.473	.933	.778	.036	.138	.087	81.7	4.1	3.6	
May 16													
2:38 a. m.	49	24	1.31	1.428	.934	.757	.030	.079	.054	80.4	5.1	4.2	P_C.
0:15 a. m.	66	35	1.09	1.501	.946	.776	.018	.096	.057	82.4	3.2	2.8	
5:03 p. m.	23	06	2.54	1.299	.851	.701	.001	.057	.029	74.9	6.4	3.8	
May 18													
4:04 a. m.	34	14	1.78	.902	.616	.505	.136	.158	.147	64.4	16.8	15.1	T_M, S aloft.
1:12 a. m.	62	38	1.12	1.157	.779	.611	.127	.115	.121	75.2	13.4	12.4	
May 19													
1:48 a. m.	56	57	1.09	1.031	.688	.573	----------	----------	----------	----------	----------	----------	T_M.
May 20													
3:49 a. m.	37	08	1.65	1.251	.828	.678	.052	.100	.076	72.6	6.0	3.7	N_{PC}.
1:23 a. m.	61	22	1.14	1.429	.933	.752	.012	.088	.065	80.8	5.4	4.7	
3:28 p. m.	40	58	1.52	1.304	.898	.690	.043	.006	.025	83.4	14.6	11.6	
May 21													
3:14 a. m.	43	27	1.45	1.271	.857	.705	.078	.122	.100	71.8	1.7	1.2	P_C.
2:43 a. m.	49	05	1.32	1.336	.859	.730	.045	.075	.060	79.4	8.6	7.2	
0:10 p. m.	67	51	1.08	1.409	.922	.739	.050	.081	.066	81.9	7.5	6.9	
May 22													
3:28 a. m.	41	21	1.51	1.222	.824	.680	.084	.130	.107	76.3	11.7	9.3	P_C.
2:23 a. m.	61	48	1.13	1.340	.903	.724	.044	.052	.048	83.3	12.5	11.2	
0:05 p. m.	67	21	1.09	1.363	.905	.733	.079	.120	.100	77.0	5.0	4.5	
2:33 p. m.	51	13	1.28	1.259	.818	.662	.086	.111	.098	74.3	8.0	6.8	
May 23													
2:01 a. m.	56	37	1.19	1.247	.712	.565	.155	.150	.152	78.0	11.5	10.3	N_{PC}, T_M aloft.
May 24													
5:00 a. m.	24	38	2.39	.814	.580	.492	.117	.178	.148	54.7	11.7	7.4	$N_{PC} \rightarrow T_M$.
3:42 a. m.	39	03	1.59	1.032	.699	.580	.119	.183	.151	61.4	6.8	5.2	
May 25													
2:40 a. m.	50	20	1.29	1.309	.837	.672	.046	.100	.073	77.7	8.5	7.2	N_{PP}, S aloft.
1:39 a. m.	60	14	1.15	1.352	.884	.684	.039	.027	.033	85.5	14.0	12.8	
May 26													
4:25 a. m.	30	00	2.00	1.073	.714	.573	.058	.093	.076	68.8	10.8	7.5	N_{PC}.
3:54 a. m.	37	04	1.65	1.244	.819	.661	.046	.087	.066	74.5	8.7	6.6	
2:47 a. m.	49	13	1.32	1.307	.854	.683	.050	.083	.066	78.4	9.2	7.7	
4:36 p. m.	29	18	2.04	1.053	.722	.589	.073	.104	.088	66.1	10.4	7.1	
May 27													
5:39 p. m.	17	53	3.23	.821	.592	.508	.091	.138	.114	50.9	7.4	3.9	T_G.
May 28													
4:14 a. m.	32	38	1.86	1.198	.849	.663	.059	.058	.058	71.9	8.4	6.0	P_C.
May 29													
4:15 a. m.	34	04	1.78	1.177	.806	.660	.073	.100	.086	70.2	7.8	5.6	P_C.
2:50 a. m.	49	01	1.32	1.347	.885	.725	.057	.119	.088	75.3	4.0	3.2	
0:09 a. m.	69	16	1.07	1.426	.912	.743	.046	.080	.063	82.0	6.4	5.9	
May 30													
4:30 a. m.	30	48	1.95	1.065	.737	.616	.096	.109	.102	64.8	8.4	5.7	P_C.
2:25 a. m.	33	28	1.25	1.264	.858	.700	.100	.138	.119	71.7	4.7	3.9	
May 31													
5:25 a. m.	20	47	2.80	.798	----------	.455	.084	----------	.084	62.0	19.7	11.6	P_C.
4:35 a. m.	29	57	2.00	1.252	.820	.684	.040	.086	.063	71.4	5.0	3.3	
3:22 a. m.	43	24	1.45	1.343	.874	.712	.037	.093	.065	73.8	2.6	1.8	
1:29 a. m.	62	27	1.13	1.414	.914	.727	.033	.065	.049	82.7	7.8	7.1	
0:07 p. m.	69	36	1.06	1.445	.929	.748	.035	.092	.064	80.9	4.3	3.9	

Atmospheric conditions during solar radiation measurements, Blue Hill Observatory of Harvard University, May 1936

Date and time from apparent noon	Air temperature	Wind, Beaufort scale	Visibility (scale 0-10)	Sky blueness	Cloudiness and remarks
	°C.				
1; 2:57 a. m.	+22.5	SE 1	7	2	Zero clouds. mod. haze.
6; 3:57 a. m.	+10.6	N 2	7	8	Few Ci; 1 Acu.
8; 4:04 a. m.	+16.1	W 3	7	8	Few Ci; few Cu; light haze.
8; 3:31 p. m.	+28.4	S 3	8	6	3 Cicu; mod. haze.
9; 2:20 a. m.	+23.06	NNW 2	6	7	3 Ci; mod. haze.
10; 3:58 p. m.	+10.3	NE 2	8	6	1 Stcu.
11; 3:01 a. m.	+15.0	SSW 3	7	8	Zero clouds; mod. haze.
11; 0.30 p. m.	+23.4	S 3	7	8	Zero clouds; mod. haze.
15; 3:31 a. m.	+13.61	SSW 3	9	8	Few Ci; light haze.
15; 0:13 a. m.	+16.9	SW 4	9	10	Few Ci.
16; 2:52 a. m.	+2.5	NW 4	10	8	Few Ci; few Cu.
16; 0:30 a. m.	+5.6	NW 4	10	10	Few Ci; few Cu; wind gusty.
20; 1:47 a. m.	+10.6	NW 5	8	8	Few Cu; light haze.
20; 3:13 p. m.	+13.9	NW 5	9	8	Few Cu.
21; 3:08 a. m.	+10.1	NW 3	8	8	1 Cu; light haze.
22; 2:02 a. m.	+10.0	NE 3	9	8	1 Ci.
22; 0:11 p. m.	+12.2	N 3	9	8	1 Ci.
23; 2:55 a. m.	+20.9	SW 3	7	8	3 Ci light haze.
24; 3:58 a. m.	+23.1	W 4	7	7	6 Ci; light haze.
26; 3:04 a. m.	+14.9	NNW 3	9	8	Few Ci; 1 Acu; few Cu, Frcu; light haze.
27; 5:51 p. m.	+18.9	SE 2	7	8	3 Acu, Stcu; 4 Cunb, Cu cong.
28; 4:10 a. m.	+11.5	WNW 5	9	8	Few Acu; 4 Cu; light haze.
29; 4:21 a. m.	+8.9	NW 3	9	8	Few Acu.
30; 4:28 a. m.	+12.2	W 1	8	6	6 Acu; few Ci; light haze.

POSITIONS AND AREAS OF SUN SPOTS

[Communicated by Capt. J. F. Hellweg, U. S. Navy (Ret.), Superintendent U. S. Naval Observatory. Data furnished by the U. S. Naval Observatory in cooperation with Harvard and Mount Wilson Observatories. The difference in longitude is measured from the central meridian, positive west. The north latitude is positive. Areas are corrected for foreshortening and are expressed in millionths of the sun's visible hemisphere. The total area for each day includes spots and groups]

Date	Eastern standard time		Heliographic			Area		Total area for each day	Observatory
			Diff. in longitude	Longitude	Latitude	Spot	Group		
1936	h	m	°	°	°				
May 1	11	5	−69.5	149.7	+12.0	31			U. S. Naval.
			−44.0	175.2	−19.0		62		
			−14.5	204.7	+17.0		62		
			−8.0	211.2	+21.5	31		186	
May 2	11	19	−57.5	148.3	+12.5		46		Do.
			−30.0	175.8	−20.0		62		
			−26.5	179.3	−16.0	8			
			+2.0	207.8	+17.0		46		
			+5.0	210.8	+21.5		31	193	
May 4	13	23	−70.0	108.3	+12.5	15			Do.
			−55.0	123.3	+13.0		31		
			−2.0	176.3	−20.0		31		
			+28.0	206.3	+19.0	15			
			+30.0	208.3	+21.5	23			
			+42.5	220.8	+15.5		31	146	
May 5	11	14	−42.0	124.2	+12.0		77		Do.
			+10.5	176.7	−19.0		46		
			+41.0	207.2	+21.0		62		
			+42.0	208.2	+17.0		46	231	
May 6	13	38	−26.0	125.7	+13.0		62		Do.
			−13.0	138.7	+12.0		46		
			−8.0	143.7	−21.5	31			
			+26.0	177.7	−19.5		31		
			+56.0	207.7	+18.0	15		185	
May 7	11	14	−83.0	56.8	−26.0		62		Do.
			−13.0	126.8	+14.0		31		
			−2.0	137.8	+13.0		62	155	
May 8	11	6	−68.0	58.6	−25.0		216		Do.
			−1.0	125.6	+16.0		77		
			+6.0	132.6	+14.5		15		
			+11.5	138.1	+14.0		185	493	
May 9	11	36	−55.0	58.1	−25.0		247		Do.
			+12.0	125.1	+15.5		93		
			+23.5	136.6	+16.0		31		
			+28.0	141.1	+13.0		77	448	
May 10	12	00	−81.0	18.7	−28.0	252			Mount Wilson.
			−75.0	24.7	−18.0	7			
			−40.0	59.7	−25.0		367		
			−7.0	92.7	−27.5	3			
			+28.0	127.7	+14.0	5			
			+42.0	141.7	+13.0		49	683	
May 11	13	10	−74.0	11.8	−29.0		494		U. S. Naval.
			−28.0	57.8	−26.0		309		
			+50.0	135.8	+15.0	31			
			+55.0	140.8	+12.0	62		896	
May 12	10	59	−62.0	11.8	−28.0		586		Do.
			−16.0	57.8	−26.0		432	1,018	
May 13	11	33	−49.0	11.3	−28.0		586		Do.
			−4.0	56.3	−25.5		370	956	
May 14	11	12	−36.0	11.2	−28.0		586		Do.
			+7.5	54.7	−27.0	23			
			+12.0	59.2	−24.5		185		
			+22.0	69.2	−25.0	31		825	
May 15	11	12	−23.0	11.0	−28.0		741		Do.
			+26.0	60.0	−24.0		185		
			+35.5	69.5	−25.0	15		941	
May 16	11	10	−60.0	320.8	+19.0		62		Do.
			−10.0	10.8	−28.0		648		
			+31.0	51.8	−29.0	15			
			+39.0	59.8	−24.0		123		
			+44.0	64.8	+21.0		62		
			+49.0	69.8	−24.0	23		935	

POSITIONS AND AREAS OF SUN SPOTS—Continued

Date	Eastern standard time		Heliographic			Area		Total area for each day	Observatory
			Diff. in longitude	Longitude	Latitude	Spot	Group		
1936	h	m	°	°	°				
May 17	11	15	−82.0	285.5	+21.0		5		Mount Wislon.
			−47.0	320.5	+18.5		28		
			+3.0	10.5	−27.0		508		
			+52.0	59.5	−24.0		24		
			+61.0	68.5	+21.0		23		
			+61.0	68.5	−25.0		3	591	
May 18	11	7	−35.5	318.9	+19.0		77		U. S. Naval.
			+15.5	9.9	−28.0		463	540	
May 19	13	46	−19.5	320.2	+19.0		46		Do.
			+28.0	7.7	−28.0		401	447	
May 20	11	15	−7.0	320.8	+19.0	15			Do.
			+41.0	8.8	−28.0		309		
			+43.0	10.8	−24.0	15		339	
May 21	11	20	−70.0	244.6	−29.0	15			Do.
			−12.0	302.6	−17.0		46		
			+48.0	2.6	−28.5	31			
			+59.0	13.6	−27.0	185		277	
May 22	11	10	+2.0	303.4	−16.5		123		Do.
			+48.0	349.4	−7.0		77		
			+60.0	1.4	−28.0	15			
			+72.0	13.4	−27.0	123		338	
May 23	11	30	−75.0	213.0	−21.0	23			Do.
			−64.0	224.0	−22.0	23			
			−22.0	266.0	+36.5		62		
			+14.0	302.0	−17.0		93		
			+62.0	350.0	−7.0		93	294	
May 24	9	00	−80.0	196.2	−16.0	114			Mount Wilson.
			−67.0	209.2	+15.0		31		
			−60.0	216.2	−20.0		9		
			−52.0	224.2	−24.0		32		
			−41.0	235.2	+17.0		3		
			−30.0	246.2	−29.0		5		
			−11.0	265.2	+36.0		14		
			+24.0	300.2	+10.0		125		
			+26.0	302.2	−15.0		30		
			+78.0	354.2	−7.0	19		382	
May 25	10	53	−64.0	197.9	−17.0		154		U. S. Naval.
			−40.0	221.9	−23.0		185		
			−36.0	225.9	−21.5		31		
			+3.0	264.9	+37.0		123		
			+38.0	299.9	+11.0		278		
			+41.0	302.9	−16.5		108	879	
May 26	14	6	−46.0	200.9	−16.0		185		Do.
			−24.0	222.9	−22.0		139		
			+21.0	267.9	+36.0	23			
			+54.0	300.9	+11.0		247		
			+57.0	303.9	−16.0		93	687	
May 27	11	31	−33.0	202.1	−16.0		185		Do.
			−12.0	223.1	−23.0		108		
			+9.0	244.1	−19.0		93		
			+66.0	301.1	+11.0		216	602	
May 28	12	9	−76.0	145.5	−18.0		123		Do.
			−19.0	202.5	−16.0		185		
			−1.0	220.5	−25.0		62		
			+24.0	245.5	−17.5		93		
			+53.0	274.5	+21.0	31			
			+76.0	297.5	+11.0		123	617	
May 29	12	10	−66.0	142.3	−17.0		247		Do.
			−6.0	202.3	−16.0		154		
			+30.0	238.3	+13.0		15		
			+34.0	242.3	−21.0		62		
			+65.0	273.3	+20.0		31	509	
May 30	12	42	−52.0	142.7	−17.0		247		Do.
			+8.0	202.7	−16.0		216	463	
May 31	13	29	−38.0	143.1	−18.0		278		Do.
			+21.0	202.1	−16.0		216		
			+51.0	232.1	+23.0		62	556	
Mean daily area for 30 days								527	

PROVISIONAL SUN-SPOT RELATIVE NUMBERS, MAY 1936

[Dependent alone on observations at Zurich and its station at Arosa]

[Data furnished through the courtesy of Prof. W. Brunner, Eidgen. Sternwarte, Zurich Switzerland]

May 1936	Relative numbers	May 1936	Relative numbers	May 1936	Relative numbers
1	*Mc* 29	11	*d* --	21	45
2	44	12	49	22	25 ?
3	47	13	*a* 71	23	--
4	*Ec* 57	14	73	24	*Mcd* 85
5	47	15	68	25	71
6	36	16	67	26	78
7	*Mcd* 46	17	*a* 64	27	65
8	46	18	47	28	*d* 68
9	46	19	36	29	68
10	40	20	26	30	*a* 48 ?
				31	78

Mean, 29 days 54.1

a = Passage of an average-sized group through the central meridian.

b = Passage of a large group or spot through the central meridian.

c = New formation of a center of activity: E, on the eastern part of the sun's disk; W, on the western part; M, in the central circle zone.

d = Entrance of a large or average-sized center of activity on the east limb.

AEROLOGICAL OBSERVATIONS

[Aerological Division, D. M. LITTLE in charge]

By L. T. SAMUELS

At those stations with a sufficient period of record for the determination of approximate normals, upper-air temperatures during May averaged close to normal. (See table 1.) The large negative departures found for Seattle are unreliable, being based on only 6 observations. Upper-air relative humidity departures were in general of opposite sign to those for temperature and of small magnitude.

The directions of the upper-air wind resultants at the 3 km level were close to normal at most stations. (See table 2.) Resultant velocities at that level exceeded the normals over the northern section of the country, and were below normal elsewhere. Departures were of small to moderate magnitude.

TABLE 1.—*Mean free-air temperatures and relative humidities obtained by airplanes during May 1936*

TEMPERATURE (° C.)

Stations	Altitude (meters) m. s. l. Surface		500		1,000		1,500		2,000		2,500		3,000		4,000		5,000		Number of observations
	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	Mean	Departure from normal	
Barksdale Field (Shreveport), La.[1] (52 m)	19.0		20.4		17.4		14.3		11.5		8.9		6.4		0.6		−5.6		31
Billings, Mont.[2] (1,088 m)	12.6						14.8		11.8		8.2		4.4		−3.4		−10.9		31
Boston, Mass.[1] (5 m)	12.0	−1.1	12.6	+0.8	10.6	+1.1	7.8	+1.0	5.0	+0.6	2.2	+0.2	−0.5	+0.1	−5.5	+0.3	−11.7	+0.2	30
Cheyenne, Wyo.[2] (1,873 m)	8.7								10.0		8.7		5.4		−2.2		−10.4		29
El Paso, Tex.[2] (1,194 m)	18.7						18.7		16.3		12.9		9.4		1.5		−6.6		31
Fargo, N. Dak.[2] (274 m)	10.9		14.4		13.2		10.8		8.4		5.3		2.1		−3.9		−10.4		31
Kelly Field (San Antonio), Tex.[1] (206 m)	19.8		20.2		18.0		15.9		13.7		11.1		8.4		2.1		−4.5		28
Lakehurst, N. J.[3] (39 m)	12.2		13.3		11.7		9.8		7.7		5.2		3.1		−2.6		−8.9		27
Maxwell Field (Montgomery), Ala.[1] (52 m)	19.4		21.5		19.0		15.4		12.5		9.4		6.9		1.6		−3.7		29
Mitchell Field (Hempstead, L. I.), N. Y.[1] (29 m)	12.1		14.4		13.3		11.4		8.5		5.9		3.4		−2.1				27
Murfreesboro, Tenn.[2] (174 m)	15.5		19.5		17.4		14.4		11.2		8.8		6.3		0.3		−5.7		30
Norfolk, Va.[3] (10 m)	16.5	−1.2	17.5	+0.3	14.9	−0.3	12.0	−0.5	8.9	−0.7	5.9	−0.9	3.7	−0.4	−2.0	−0.7	−8.5	−1.2	22
Oklahoma City, Okla.[2] (391 m)	18.1		18.7		17.9		15.1		11.7		8.8		5.8		−0.6		−6.9		30
Omaha, Nebr.[3] (300 m)	16.3	+2.7	17.6	+3.1	16.3	+2.1	13.4	+1.4	10.8	+1.2	7.6	+0.9	4.2	+0.6	−2.6	+0.6	−9.4	+0.7	31
Pensacola, Fla.[3] (13 m)	20.3	−2.0	20.6	−0.2	17.8	−0.3	14.5	−1.2	11.7	−0.9	9.0	−1.0	6.6	−0.9	1.4	−0.5	−3.9	+0.2	30
San Diego, Calif.[3] (10 m)	16.5	−0.9	14.5	+0.4	15.3	+1.3	15.8	+2.7	14.1	+2.2	11.7	+2.3	8.8	+2.2	3.3	+2.7	−2.8	+3.0	30
Scott Field (Belleville), Ill.[1] (135 m)	13.7		18.5		16.7		13.2		10.4		7.9		4.9		−1.3		−7.5		30
Seattle, Wash.[3] (10 m)	12.9	−0.2	7.3	−2.7	4.2	−3.5	0.9	−4.1	−2.3	−4.5	−5.1	−4.6	−8.5	−5.4	−16.3	−7.1	−26.0	−10.4	6
Selfridge Field (Mount Clemens), Mich.[1] (177 m)	11.8		14.6		12.8		9.5		6.0		3.0		0.3		−5.1		−11.9		27
Spokane, Wash.[3] (596 m)	11.0				14.5		14.1		12.0		8.8		5.5		−1.5		−9.0		31
Washington, D. C.[3] (13 m)	14.4	−1.9	15.9	+0.9	13.9	+0.8	11.6	+1.0	9.0	+0.9	6.4	+0.9	3.8	+0.9	−2.0	+0.5	−7.6	+0.8	30
Wright Field (Dayton), Ohio[1] (244 m)	12.7		16.7		15.1		12.2		9.2		6.4		3.8		−2.0		−8.1		30

RELATIVE HUMIDITY (PERCENT)

Stations	Surface Mean	Departure from normal	500 Mean	Departure from normal	1,000 Mean	Departure from normal	1,500 Mean	Departure from normal	2,000 Mean	Departure from normal	2,500 Mean	Departure from normal	3,000 Mean	Departure from normal	4,000 Mean	Departure from normal	5,000 Mean	Departure from normal	Number of observations
Barksdale Field (Shreveport), La.	85		61		64		66		61		56		53		49		32		
Billings, Mont.	54						44		44		45		48		53		48		
Boston, Mass.	73	+6	61	+1	61	+3	63	+5	59	+2	56	+2	52	0	49	+2	47	+1	
Cheyenne, Wyo.	70								63		53		50		53		56		
El Paso, Tex.	45						47		47		47		47		51		57		
Fargo, N. Dak.	77		63		57		53		52		52		53		54		49		
Kelly Field (San Antonio), Tex.	93		87		84		77		71		67		60		53		47		
Lakehurst, N. J.	80		65		61		61		57		56		48		46		38		
Maxwell Field (Montgomery), Ala.	80		60		60		67		62		64		58		48		37		
Mitchel Field (Hempstead, L. I.), N. Y.	85		77		73		72		76		65		63		58				
Murfreesboro, Tenn.	79		62		60		63		65		56		50		40		35		
Norfolk, Va.	77	+4	58	−4	62	+4	64	+7	63	+7	59	+4	50	−1	36	−4	33	−4	
Oklahoma City, Okla.	83		75		60		59		50		57		51		45		38		
Oma, Nebr.	78	0	66	−5	60	−3	60	0	56	−1	58	+3	55	+3	54	+5	53	+6	
Pensacola, Fla.	89	+6	77	0	77	+6	80	+14	74	+14	68	+14	61	+12	53	+13	46	+11	
San Diego, Calif.	79	+7	79	+1	57	−6	35	−15	28	−10	24	−9	22	−7	18	−8	16	−8	
Scott Field (Belleville), Ill.	84		58		53		56		55		46		44		35		32		
Seattle, Wash.	72	−1	73	−1	72	+1	72	+3	75	+7	68	+5	68	+10	65	+9	64	+11	
Selfridge Field (Mount Clemens), Mich.	83		60		54		58		60		57		52		42		38		
Spokane, Wash.	69				59		55		55		57		60		61		59		
Washington, D. C.	79	+10	55	−5	52	−4	45	−10	47	−8	48	−6	47	−5	45	−3	36	−8	
Wright Field (Dayton), Ohio	86		63		58		60		61		57		53		49		46		

Observations taken about 4 a. m., 75th meridian time, except along the Pacific coast and Hawaii where they are taken at dawn.

[1] Army.
[2] Weather Bureau.
[3] Navy.

NOTE.—The departures are based on "normals" covering the following total number of observations made during the same month in previous years, including the current month: Boston, 103; Norfolk, 151; Omaha, 155; Pensacola, 196; San Diego, 174; Seattle, 73; Washington, 223.

TABLE 2.—*Free-air resultant winds (meters per second) based on pilot-balloon observations made near 5 a. m. (E. S. T.) during May 1936*

[Wind from N=360°, E=90°, etc.]

Altitude (m) m. s. l.	Albuquerque, N. Mex. (1,554 m)		Atlanta, Ga. (309 m)		Billings, Mont. (1,088 m)		Boston, Mass. (15 m)		Cheyenne, Wyo. (1,873 m)		Chicago, Ill. (192 m)		Cincinnati, Ohio (153 m)		Detroit, Mich. (204 m)		Fargo, N. Dak. (274 m)		Houston, Tex. (21 m)		Key West, Fla. (11 m)		Medford, Oreg. (410 m)		Murfreesboro, Tenn. (180 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	47	1.6	13	0.5	275	2.6	266	2.4	284	2.7	179	1.3	58	0.4	254	1.7	172	1.1	85	2.0	90	2.7	287	0.1	10	0.4
500			119	1.6			283	8.0			223	5.7	197	1.7	271	4.5	215	4.3	134	6.3	99	5.0	290	0.4	159	2.5
1,000			129	2.8			284	7.3			249	5.4	262	3.7	278	6.1	257	4.7	134	5.4	107	5.0	284	1.1	196	3.7
1,500			119	1.8	231	4.2	282	8.9			269	5.9	273	5.6	281	6.7	270	4.4	137	3.2	97	3.3	140	0.7	217	3.3
2,000	175	1.2	147	1.5	244	4.5	279	9.4	273	3.7	279	6.6	270	6.9	284	7.8	291	4.9	149	1.9	87	2.2	149	1.6	241	3.1
2,500	225	2.6	136	2.6	260	4.6	285	10.9	270	4.4	293	6.7	270	7.2	297	8.1	307	4.0	142	0.8	108	1.3	195	2.7	266	2.5
3,000	249	3.5	177	2.2	267	4.8	283	10.8	264	3.0	297	6.7	286	8.4	298	10.0	255	6.2	147	0.8	65	0.4	204	2.5	257	1.5
4,000	266	4.2	200	2.6	275	5.0	285	10.1	272	3.4	307	14.6	302	11.6	286	12.1	315	5.3	40	1.0	253	2.4	227	3.5	206	2.8
5,000	255	3.7	187	2.0	277	5.3	295	11.1	304	5.5	301	13.2			284	11.8			16	1.9			260	5.4	302	1.4

Altitude (m) m. s. l.	Newark, N. J. (14 m)		Oakland, Calif. (8 m)		Oklahoma City, Okla. (402 m)		Omaha, Nebr. (306 m)		Pearl Harbor, Territory of Hawaii [1] (68 m)		Pensacola, Fla.[1] (24 m)		St. Louis Mo. (170 m)		Salt Lake City, Utah (1,294 m)		San Diego, Calif. (15 m)		Sault Ste. Marie, Mich. (198 m)		Seattle, Wash. (14 m)		Spokane, Wash. (603 m)		Washington, D. C. (10 m)	
	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity	Direction	Velocity
	°		°		°		°		°		°		°		°		°		°		°		°		°	
Surface	292	1.3	226	0.5	166	2.7	146	1.5	57	5.0	78	4.1	183	1.1	155	3.1	42	0.6	29	0.4	162	1.3	148	0.9	304	0.5
500	302	6.8	213	2.3	153	3.6	174	3.5	69	8.2	90	6.7	188	4.8			324	1.9	343	1.0	178	0.8			283	5.0
1,000	305	5.8	346	4.3	175	8.6	208	6.9	72	9.1	110	5.0	231	4.7			344	3.6	290	5.9	208	1.5	206	2.0	292	4.9
1,500	287	6.8	332	3.2	186	4.9	226	7.2	84	7.8	132	3.5	238	4.0	160	3.7	331	4.1	284	6.2	244	1.6	224	3.4	293	5.1
2,000	277	8.2	321	3.0	194	2.8	231	6.6			126	2.7	247	3.3	176	3.0	322	2.9	313	10.2	245	3.5	216	2.1	294	7.3
2,500	281	9.4	326	4.2	210	2.2	245	3.5			139	1.8	309	3.8	208	2.0	344	2.9	318	11.1	245	5.6	213	2.7	295	8.3
3,000	286	8.0	307	3.3	238	1.5	306	3.4			115	2.1	318	3.8	218	2.3	341	4.4	322	13.1	249	7.3	226	4.3	288	9.4
4,000			273	8.7	94	0.5	339	2.9			31	1.1			225	4.7	317	6.5	329	15.2	241	9.8	243	5.8	291	10.0
5,000					32	1.4									276	4.3	294	4.6	324	18.8			235	8.0		

[1] Navy stations.

RIVERS AND FLOODS

[River and Flood Division, Montrose W. Hayes in charge]

By W. J. Moxom

Floods did not occur during May in any of the major streams of the United States, although stages in the lower Mississippi River were fairly high during the first part of the month because of the discharge from the Ohio River flood of March and April. Light to moderate floods occurred in widely separated sections in several of the smaller streams. The most severe was in southeastern Colorado, where torrential rain on May 30 caused a rapid rise to above flood stage in the Arkansas River in the vicinity of Lamar and Holly, Colo., including the tributaries both north and south of the main stream. Newspaper and other accounts report the loss of six lives in southeastern Colorado and the adjacent area in western Kansas. Reported estimates of property losses in this vicinity total nearly $500,000. Estimated flood losses elsewhere during May amount to $34,300.

The following remarks are compiled from reports rendered by the various district centers:

Columbia, S. C.—The Santee River at Rimini and Ferguson, S. C., was slightly above flood stage during the first few days of the month; this was a continuation of the April flood. No flood losses occurred in May.

Meridian, Miss.—Moderately heavy to heavy rains occurred over the Meridian river district during the last 3 days of April, causing a rapid rise in the rivers. Prior to these rains the streams were all seasonably low, indicating a dry soil, with the swamps relatively dry. This condition accounts for the fact that only a light flood occurred in the central and lower Pearl watersheds, while flood stages were not reached in the Pascagoula watershed. Estimated flood losses in the Pearl River system from all sources were $10,250.

La Crosse, Wis.—For the third time this season the upper Mississippi was near flood stage. The crest passed La Crosse at 11 a. m. of the 13th, with a stage of 10.83. The only station at which flood stage was reached was Durand, Wis., on the Chippewa River, where a crest of 11.3 feet, 0.3 foot above flood level, occurred on the 9th. The high water during May was caused by frequent heavy rains in the headwaters during the first week of the month. After the 15th the rivers began to fall at a rapid rate. Flood losses during the month were very light.

Topeka, Kans.—The only overflow in the district during May was a slight one of the upper Solomon River, which reached a crest of 22.2 feet (4.2 above flood stage) at Beloit, Kans., on the 12th. The total estimated damage was $1,300, the greater part of which was to prospective crops.

Concordia, Kans.—Slight flooding occurred during the month in the lower Republican River. Estimated losses amounted to about $500 to growing crops, mostly in the vicinity of Junction City, Kans.

Indianapolis, Ind.—Flood stages were passed on the Wabash River at La Fayette, Covington, and Terre Haute, Ind. While there was a considerable rise in the river above La Fayette no flooding occurred in that reach. Below Terre Haute the flood flattened rapidly, owing to the light rainfall over the lower reach, and stages were considerably short of flood below Terre Haute. Losses were negligible.

Wichita, Kans.—There was flooding of lowlands between Syracuse and Dodge City, owing to heavy rains in eastern Colorado and western Kansas during the last few days of May. Damages were not reported.

Shreveport, La.—Moderate flooding occurred in the Sulphur River in northeast Texas, with the estimated damages amounting to about $12,000, the greater part to growing crops.

Dallas, Tex.—There was a light flood in the Trinity River in the vicinity of Dallas, Tex. Some growing crops were overflowed, but resulting losses were very light.

San Antonio, Tex.—Moderately heavy flooding occurred in the Colorado and Guadalupe Rivers in Texas, and stages continued high into June. An estimate of flood losses is not available at this date.

Albuquerque, N. Mex.—A flash flood occurred at Fort Sumner, N. Mex., near the headwaters of the Pecos River, on the night of the 28–29th. The river remained above flood stage slightly less than 6 hours. Dykes and bridges at the Alamegordo Dam above Fort Sumner were damaged approximately $10,000 by the flood.

Brownsville, Tex.—The Rio Grande reached flood stage at Brownsville on one day, but without overflow anywhere except through a few breaks of little consequence.

Denver, Colo.—Flood stages were slightly exceeded at Eagle, Carbondale, and Delta, Colo., on tributaries of the Colorado River, several times during the month. Losses from these floods were negligible.

Heavy local rainfall occurred on May 30 in southeastern Colorado causing a rapid rise to above flood stage in the Arkansas River in the vicinity of Lamar to Holly, Colo., and in the tributaries both to the north and south of the main stream. From newspaper and other accounts it appears that six persons lost their lives in these floods in southeastern Colorado and the adjacent area in western Kansas. Property losses at Lamar, Carlton, and Holly, and their immediate vicinities, amounted to approximately $500,000.

Table of flood stages during May 1936

[All dates in May unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
EAST GULF OF MEXICO DRAINAGE					
Pearl:	*Feet*			*Feet*	
Jackson, Miss	18	Apr. 30	6	21.9	3
Monticello, Miss	15	Apr. 30	4	17.9	3
Columbia, Miss	17	5	5	17.0	5
Pearl River, La	12	6	13	14.4	9
MISSISSIPPI SYSTEM					
Upper Mississippi Basin					
Chippewa: Durand, Wis	11	9	9	11.3	9
Wisconsin: Knowlton, Wis	12	6	8	15.7	7
Missouri Basin					
Solomon: Beloit, Kans	18	11	12	22.2	12
Republican: Clay Center, Kans	12	11	12	13.3	11
Ohio Basin					
West Fork of White: Anderson, Ind	8	2	6	10.4	3
Wasbash:					
La Fayette, Ind	11	3	5	15.4	4
Covington, Ind	16	3	6	18.95	5
Terre Haute, Ind	14	5	8	15.1	7

Table of flood stages during May 1936—Continued

[All dates in May unless otherwise specified]

River and station	Flood stage	Above flood stages—dates		Crest	
		From—	To—	Stage	Date
MISSISSIPPI SYSTEM—continued					
Arkansas Basin					
North Canadian:	*Feet*			*Feet*	
Woodward, Okla	5	25	26	5.5	25, 26
		28	31	6.0	29, 30
Canton, Okla	6	26	26	6.0	26
		30	(1)	6.6	31
Yukon, Okla	8	12	13	8.6	12
		27	(1)	9.9	31
Arkansas: Lamar, Colo	8	30	30	9.0	30
Red Basin					
Sulphur:					
Ringo Crossing, Tex	20	9	13	23.4	10
Naples, Tex	22	14	19	26.0	15
Lower Mississippi Basin					
Mississippi: Natchez, Miss	46	Apr. 30	3	46.1	1–3
Atchafalaya Basin					
Atchafalaya: Atchafalaya, La	22	Apr. 21	12	23.1	4–7
WEST GULF OF MEXICO DRAINAGE					
Trinity: Dallas, Tex	28	29	30	29.1	29
Colorado:					
Columbus, Tex	24	24	29	33.0	25
Wharton, Tex	26	25	(1)	36.6	27
Guadalupe:					
Gonzales, Tex	20	26	26	20.8	26
		28	29	21.8	29
Victoria, Tex	21	24	(1)	29.6	25
Pecos: Fort Sumner, N. Mex	5	28	29	5.9	29
Rio Grande:					
Espanola, N. Mex	7	5	8	7.2	8
Brownsville, Tex	18	12	12	18.1	12
GULF OF CALIFORNIA DRAINAGE					
Colorado Basin					
Eagle: Eagle, Colo	5	21	21	5.0	21
		26	27	5.1	26
		30	(1)	5.3	31
Roaring Fork of Colorado: Carbondale, Colo	5	16	(1)	6.2	30
Gunnison: Delta, Colo	9	4	7	10.6	6
		15	22	9.7	17, 18
PACIFIC SLOPE DRAINAGE					
Columbia Basin					
Clearwater: Kamiah, Idaho	12	3	6	13.6	4
		11	18	15.2	15
Willamette: Portland, Oreg	18	16	24	19.4	18
Columbia: Vancouver, Wash	15	6	(1)	20.0	18

[1] Continued into June.

WEATHER ON THE ATLANTIC AND PACIFIC OCEANS

[The Marine Division, I. R. TANNEHILL in charge]

NORTH ATLANTIC OCEAN, MAY 1936

By H. C. HUNTER

Atmospheric pressure.—Pressure was mostly higher than normal, especially over the northern British Isles and adjacent waters. Of the daily values secured from Lerwick, Shetland Islands, only those of the last 2 days were lower than the normal for May at that station. Over the southwestern part of the ocean, however, the pressure averaged less than normal.

The extremes of pressure found from vessel data are 30.64 and 29.17 inches. The higher reading was noted 300 miles to south-southeastward of Nantucket on the morning of the 23d, by the British motorship *Silverbeech*. The lower mark was recorded on the British motor tanker *San Alvaro*, at noon of the 14th, when the vessel was 350 miles west of Valencia, Ireland. Table 1 indicates that 2 days before the *San Alvaro's* reading the pressure at Reykjavik, Iceland, was almost a quarter of an inch lower, namely 28.94 inches.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure (sea level) at selected stations for the North Atlantic Ocean and its shores, May 1936*

Stations	Average pressure	Departure	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Julianehaab, Greenland	29.76	--------	30.43	27, 28	29.22	2, 3
Reykjavik, Iceland	29.96	+0.04	30.54	27	28.94	12
Lerwick, Shetland Islands	30.17	+.37	30.40	4	29.76	30
Valencia, Ireland	30.06	+.11	30.37	1	29.68	5
Lisbon, Portugal	29.96	−.01	30.09	10, 28	29.73	19
Madeira	30.04	+.03	30.16	17	29.90	3
Horta, Azores	30.24	+.08	30.43	16, 17	29.98	27
Belle Isle, Newfoundland	29.92	+.03	30.34	4	29.54	18
Halifax, Nova Scotia	29.99	+.02	30.46	22	29.50	28, 29
Nantucket	30.01	+.02	30.59	22	29.44	28
Hatteras	30.06	+.05	30.50	22	29.65	28
Bermuda	30.06	−.05	30.28	21, 23	29.78	31
Turks Island	29.93	−.07	29.99	4	29.84	21, 22
Key West	29.94	−.03	30.06	1	29.71	28
New Orleans	29.99	+.02	30.18	22	29.65	28

NOTE.—All data based on a. m. observations only, with departures compiled from best available normals related to time of observation, except Hatteras, Key West, Nantucket, and New Orleans, which are 24-hour corrected means.

Cyclones and gales.—There were about as many reports of gales as are usually noted in May, but no well-developed storm center is indicated in the parts of the North Atlantic which are covered by vessel reports.

The strongest gales, including two instances of force 11, were encountered about 400 to 700 miles to westward of Ireland during the period 11th to 15th. At this time pressure was very low over the greater part of the Greenland-Iceland area, while it was moderately high over the Azores and thence westward toward Bermuda.

Not so intense, but quite notable for the region of occurrence, were the gales met in the waters adjacent to Florida and the northern Bahamas from the 19th to 23d. During this period lower pressure than normal was indicated over Cuba and the southern Bahamas, while a strong HIGH passed southeastward over the Lake region.

Somewhat earlier, on the 14th, an intensified trade of fresh gale strength was experienced but a short distance north of the Panama Canal.

Fog.—There was no fog reported in any part of the Gulf of Mexico nor anywhere in the ocean to southward of the thirty-fifth parallel; but in most other areas where fog occurs to an appreciable extent there was a notable increase in May over the frequency during the preceding month, and very often there was much more than normally is noted during May. In the 5° square 40° to 45° N., 45° to 50° W., there were no less than 24 days with fog; and to northward and westward of this square, fog occurred very frequently.

From the vicinity of Nova Scotia to Chesapeake Bay there was much fog during the first half of the month, but almost none afterward. During the period from 2d to 4th the fog led to several accidents in the coastal waters from Cape Cod to Delaware Bay, groundings being most frequent. The American steamship *Angelina*, inbound to New York, struck an anchored fishing boat, one man being killed and four missing. In Nantucket Sound the British steamship *Canadian Planter* sank as the result of a collision, but there was no loss of life and the vessel was presently refloated.

Near the British Isles, and to westward and southwestward as far as the twenty-fifth meridian, fog was noted to a moderate extent, but almost wholly during the 8-day period from the 4th to 11th, inclusive.

OCEAN GALES AND STORMS, MAY 1936

Vessel	Voyage: From—	Voyage: To—	Position at time of lowest barometer: Latitude	Position at time of lowest barometer: Longitude	Gale began May	Time of lowest barometer May	Gale ended May	Lowest barometer	Direction of wind when gale began	Direction and force of wind at time of lowest barometer	Direction of wind when gale ended	Direction and highest force of wind	Shifts of wind near time of lowest barometer
NORTH ATLANTIC OCEAN			° ′	° ′				Inches					
Jean Jadot, Belg. S. S.	Antwerp	New York	47 40 N.	37 41 W.	1	10a, 1	1	30.04	WSW	WSW, 7	WNW	WSW, 8	WSW-WNW.
Maine, Dan. S. S.	Copenhagen	do	57 30 N.	22 00 W.	3	10a, 2	5	[1]29.20	SW	SW, 7	WNW	WNW, 8	
Quaker City, Am. S. S.	Liverpool	Boston	51 18 N.	20 59 W.	4	Noon, 4	7	29.60	WNW	WNW, 8	NE	NW, 10	W-NW.
Boston City, Br. S. S.	Swansea	Montreal	46 37 N.	52 49 W.	5	4p, 5	5	29.71	SW	SW, 7	W	SW, 8	SW-W.
Irene, Du. S. S.	Guatemala	Amsterdam	45 53 N.	16 05 W.	5	6a, 6	6	29.70	NNW	NNW, 8	N	NNW, 9	None.
Maine, Dan. S. S.	Copenhagen	New York	51 40 N.	45 30 W.	8	4p, 8	9	[1]29.50	W	W, 8	WNW	WSW, 9	WSW-NNW.
Exermont, Am. S. S.	Casablanca	do	35 34 N.	57 40 W.	10	8a, 10	10	30.02	SSE	SSE, 8	SSE	SSE, 8	SSE-S.
American Shipper, Am. S. S.	Belfast	do	52 37 N.	22 15 W.	11	7a, 11	11	29.52	SW	WSW, 7	WNW	WNW, 9	S-W.
Georgia, Dan. S. S.	Oslo	Portland, Maine.	55 20 N.	24 38 W.	11	9a, 11	12	29.17	SSE	N, 11	W	NW, 11	SSE-SSW-NW.
American Shipper, Am. S. S.	Belfast	New York	49 58 N.	30 34 W.	12	Noon, 12	12	29.64	SSW	SSW, 8	NW	SSW, 8	SSW-NW.
Volendam, Du. S. S.	Rotterdam	do	48 53 N.	29 10 W.	13	Mdt., 13	14	29.53	W	W, 8	NNW	W, 8	S-W-NW.
Pierre L. D., Fr. M. S.	Nordenham	Montreal	50 42 N.	26 08 W.	13	6a, 14	15	[1]29.09	SSW	NW, 10	SW	NW, 11	
Santa Maria, Am. S. S.	Cristobal	New York	10 06 N.	79 24 W.	14	7a, 14	15	29.62	NE	NE, 4	NE	NE, 8	None.
San Alvaro, Br. M. S.	Ardrossan	Tampico	51 43 N.	19 57 W.	12	Noon, 14	17	29.17	SW	SW, 9	NW	W, 10	SW-WNW.
Europa, Ger. S. S.	Cherbourg	New York	[2]49 16 N.	15 50 W.	14	4p, 14	15	29.58	SSW	SW, 6	NW	W, 8	SSW-NW.
Duquesne, Am. S. S.	New Orleans	Havre	49 10 N.	12 25 W.	17	4p, 19	19	30.12	N	NE, 6	NE	NNE, 8	None.
Macabi, Pan. S. S.	Preston, Cuba	Boston	25 26 N.	74 00 W.	20	7p, 20	20	29.83	ENE	NNE, 9	NNE	NNE, 9	ENE-NNE-ESE.
General Gassouin, Fr. M. S.	Baytown, Tex.	New York	26 20 N.	79 50 W.	21	2p, 21	23	29.85	NNE	NNE	ENE	ENE, 8	NNE-ENE.
Bilderdyk, Du. S. S.	Norfolk	Corpus Christi.	27 49 N.	80 10 W.	21	8p, 21	22	29.90	ENE	ENE, 7	ENE	E, 8	None.
Steel Trader, Am. S. S.	Cristobal	Boston	23 06 N.	74 24 W.	22	7a, 22	24	29.88	ENE	SW, 1	ENE	ENE, 9	
El Isleo, Am. S. S.	Galveston	Baltimore	[2]24 42 N.	81 27 W.	23	1p, 22	23	29.86	E	ENE, 6	E	E, 8	NE-E.
Saccarappa, Am. S. S.	Savannah	Liverpool	39 50 N.	55 49 W.	22	3p, 24	25	29.72	NW	NNW, 8	NNW	N, 9	N-NNW.
Boston City, Br. S. S.	Montreal	Cardiff	[2]51 44 N.	53 08 W.	27	2a, 27	28	29.74	ESE	NNE, 5	SSE	SE, 8	
Saccarappa, Am. S. S.	Savannah	Liverpool	43 27 N.	41 38 W.	27	7p, 27	28	29.91	S	S, 7	S	S, 8	
Exochorda, Am. S. S.	New York	Gibraltar	39 49 N.	59 58 W.	28	6a, 28	28	30.32	S	S, 6	S	S, 8	
Paris, Fr. S. S.	Havre	New York	42 50 N.	47 30 W.	31	8p, 31	31	29.84	S	S, 8	SW	S, 8	
NORTH PACIFIC OCEAN													
W. S. Rheem, Am. S. S.	Yokohama	San Francisco	42 25 N.	168 55 E.	2	11p, 1	3	29.25		SSW, 4	W	W, 9	
Saparoea, Du. M. S.	Singapore	do	45 54 N.	162 57 W.	3	8p, 2	3	29.27	W	WSW, 6	W	W, 9	None.
Kwanto Maru, Jap. M. S.	Los Angeles	Yokohama	40 40 N.	132 20 W.	2	4a, 2	5	29.60	W	SW, 5	WSW	W, 9	SW-W.
Hiye Maru, Jap. M. S.	Seattle	do	51 59 N.	147 58 W.	4	2p, 5	6	[1]29.13	SW	SSW, 8	SW	WSW, 9	SSW-WSW.
Socony-Vacuum, Am. S. S.	San Francisco	do	47 00 N.	151 30 W.	3	6a, 5	7	29.56	W	S, 8	WSW	S, 9	S-SW.
Athelchief, Br. M. S.	do	do	34 53 N.	146 01 E.	7	7a, 7	7	29.49	S	SW, 9	NW	SW, 9	S-NW.
San Pedro Maru, Jap. M. S.	Yokohama	San Francisco	41 35 N.	154 08 E.	7	8p, 7	9	29.11	S	S, 6	W	SW, 8	S-SW.
Hiye Maru, Jap. M. S.	Seattle	Yokohama	50 41 N.	176 51 W.	8	Noon, 8	11	[1]29.61	SE	SW, 7	WNW	W, 10	
Socony-Vacuum, Am. S. S.	San Francisco	do	47 57 N.	178 05 W.	9	Noon, 11	11	30.08	W	W, —	W	W, 8	Steady.
Heiyo Maru, Jap. M. S.	Los Angeles	do	46 42 N.	173 15 W.	12	5p, 12	12	29.45	WSW	WSW, 7	NW	WSW, 8	SW-NW.
Potter, Am. M. S.	Hinigaran	Los Angeles	40 17 N.	142 45 W.	12	4a, 13	13	29.65	NW	NW, 8	NW	WNW, 9	NW-WNW.
Pres. McKinley, Am. S. S.	Victoria, B. C.	Yokohama	48 32 N.	168 53 E.	17	2p, 17	18	28.88	E	NNE, 8	NNW	N, 10	NE-N.
Falsterbo, Swed. M. S.	Kobe	Port Alberni	33 55 N.	137 20 E.	19	1p, 19	19	[1]29.61	ESE	ESE, 5	E	ESE, 11	
Silverguava, Br. M. S.	Singapore	San Francisco	[2]19 47 N.	121 28 E.	20	4a, 20	20	29.68	E	SE, 5	NE	NE, 8	Steady.
Do	do	do	34 06 N.	145 54 E.	25	10p, 24	25	29.62	NE	N, 5	NE	NNE, 8	
Falsterbo, Swed. M. S.	Kobe	Port Alberni	41 07 N.	159 45 E.	25	Noon, 25	27	[1]29.72	ENE	E, 7	NW	NE, 9	
Empress of Asia, Br. S. S.	Yokohama	Victoria	38 19 N.	144 23 E.	24	9a, 28	28	28.78	NE	NW, 5	NW	NW, 10	
Pres. Jackson, Am. S. S.	do	do	35 18 N.	142 00 E.	31	11 p, 31	[3]2	29.24	E	NE, 9	NW	N, 10	NE-N.

[1] Barometer uncorrected. [2] Position approximate. [3] June.

NORTH PACIFIC OCEAN, MAY 1936

By WILLIS E. HURD

Atmospheric pressure.—The pressure distribution was abnormal for the season over northern and central North Pacific waters during May 1936, and constituted a distinct reversal to winter type. The Aleutian LOW was strongly developed, and at Dutch Harbor the average pressure, 29.38 inches, was 0.46 below the normal of the month. The reading is the lowest of record for May at this station.

The North Pacific anticyclone showed a high degree of development in midocean, as indicated by the record high average of 30.23 inches for May, at Midway Island.

In the Far East, pressure anomalies occurred at Naha and Chichishima; the average reading at Naha was 0.13 inch above, and at Chichishima 0.06 below, the normal.

In other parts of the ocean, near normal average pressures prevailed.

TABLE 1.—*Averages, departures, and extremes of atmospheric pressure at sea level, North Pacific Ocean, May 1936, at selected stations*

Stations	Average pressure	Departure from normal	Highest	Date	Lowest	Date
	Inches	*Inch*	*Inches*		*Inches*	
Point Barrow	29.93	−0.16	30.38	1	29.58	25
Dutch Harbor	29.38	−.46	30.10	8	28.80	28, 29
St. Paul	29.43	−.41	30.04	8	28.86	4
Kodiak	29.67	−.17	30.18	9	28.70	4
Juneau	29.94	−.05	30.34	10	29.42	4
Tatoosh Island	30.02	+.01	30.55	6	29.51	26
San Francisco	29.98	−.01	30.23	6	29.75	26
Mazatlan	29.83	−.02	29.96	5	29.76	25, 28
Honolulu	30.07	+.02	30.15	3	29.98	9
Midway Island	30.23	+.18	30.36	6	30.00	27
Guam	29.85	−.03	29.92	1, 31	29.80	11, 13, 14
Manila	29.78	+.01	29.84	1, 2, 3	29.68	15
Hong Kong [1]						
Naha	29.95	+.13	30.12	1	29.78	14, 17, 30
Chichishima	29.85	−.06	29.98	6	29.64	17
Nemuro [1]						

[1] Data missing.

NOTE.—Data based on 1 daily observation only, except those for Juneau, Tatoosh Island, San Francisco, and Honolulu which are based on 2 observations. Departures are computed from best available normals related to time of observation.

Cyclones and gales.—Despite the prevailing low pressure over the Aleutian region, in conjunction with the steady high pressure in middle latitudes to the southward, no undue storminess was experienced by steamships traversing the upper routes. On several days along the middle and western parts of these routes pressures fell to 29 inches or lower, but they were accompanied as a rule by fresh gales (force 8) to strong gales (force 9) only. Gales of force 10 occurred south of the central and western Aleutians on the 11th and 17th, and east of Honshu on the 28th. In the gales of the 28th, the British steamer *Empress of Asia* reported the lowest pressure reading, 28.78 inches, of the month. Ou the 19th, the Swedish steamer *Falsterbo* reported the severest May gale, force 11 from east-southeast, in connection with a small shallow disturbance south of Honshu.

To the eastward of the one hundred and sixtieth meridian of west longitude, gales of force 8–9 were reported locally on the 4th, 5th, and 12th, and over a larger area on the 13th. Those of the 4th and 5th were due to a deep cyclone, central over and near the Alaska Peninsula, with a southeastward extension to the coast of the United States. The gale on the 4th occurred near 41° N., 132° W., and was the closest to the mainland reported for the month.

The gales of the 12th–13th occurred in connection with a depression which appeared east of the Hawaiian Islands on the 9th and thereafter moved northward toward the Gulf of Alaska. The lowest barometer reported in this disturbance was 29.09 on the 13th, near 41° N., 136° W. This day was also the stormiest, with gales experienced by several ships within the region 35°–45°N., and 138°–150° W.

Generally quiet weather prevailed in the Tropics. In the Far East the only low-latitude gale reported was of force 8, barometer 29.68, near the north end of the island of Luzon on the 20th. Off the coast of Costa Rica a northeaster of force 7 was experienced on the 1st.

Fog.—As usual in May, fog showed a decided seasonal increase in frequency over the western part of the northern and central steamship routes. East of Honshu and northwest of Midway Island, in two 5° squares it was reported on 5 days. From the western Aleutians southwestward toward Japan, fog was observed on from 2 to 4 days within 5° squares. East of 170° E., scattered fog occurred in higher latitudes to the American coast. There were 3 days with fog noted off the Washington and California coasts, and 4 off the Peninsula of California. Dense fog off Prince of Wales Island, Alaska, caused the temporary grounding of the American steamer *North Sea* on the 14th, according to the Maritime Register.

SMALL TYPHOON IN THE FAR EAST, APRIL 18–22, 1936

By BERNARD F. DOUCETTE, S. J.

[Weather Bureau, Manila, P. I.]

A low-pressure area south of the Western Caroline Islands on April 18 and 19 developed into a depression April 20, central about 300 miles west by north of the Palau Islands. As this disturbance moved rapidly northwest, it developed into a small typhoon which entered Samar Island during the early morning hours of the 21st; at 6 a. m. it was located over the central part of the northern coast of that island. Continuing the same northwest course, but moving more slowly, it proceeded across southern Luzon, and the next day found it shifting to the north as it entered the Pacific Ocean, where it disappeared a short distance east of northern Luzon.

Barometric minima reported below 750 mm (29.53 inches) are as follows: Borongon, Samar, 748.26 mm (29.458 inches) with west winds force 6. Calbayog, Samar, 748.51 mm (29.468 inches) with west-northwest winds force 4. Legaspi, Albay, 745.60 mm (29.354 inches) with west-southwest winds force 5. Naga, Camarines Sur, 748.31 mm (29.461 inches) with northwest winds force 4. Daet, Camarines Norte, 743.39 mm (29.268 inches) with northeast winds force 3. The most violent winds were of force 8, from the southwest quadrant, and occurred at various stations while the center was moving away from the locality. The total loss of life was 9; 7 deaths were reported from Camarines Norte, and 2 from Samar.

CLIMATOLOGICAL TABLES

CONDENSED CLIMATOLOGICAL SUMMARY

In the following table are given for the various sections of the climatological service of the Weather Bureau the monthly average temperature and total rainfall; the stations reporting the highest and lowest temperatures, with dates of occurrence; the stations reporting the greatest and least total precipitation; and other data as indicated by the several headings.

The mean temperature for each section, the highest and lowest temperatures, the average precipitation, and the greatest and least monthly amounts are found by using all trustworthy records available.

The mean departures from normal temperatures and precipitation are based only on records from stations that have 10 or more years of observations. Of course, the number of such records is smaller than the total number of stations.

Condensed climatological summary of temperature and precipitation by sections, May 1936

[For description of tables and charts, see REVIEW, January, p. 29]

Section	Temperature								Precipitation					
	Section average	Departure from the normal	Monthly extremes						Section average	Departure from the normal	Greatest monthly		Least monthly	
			Station	Highest	Date	Station	Lowest	Date			Station	Amount	Station	Amount
	°F.	°F.		°F.			°F.		In.	In.		In.		In.
Alabama	73.6	+2.3	Florence	97	8	2 stations	43	14	1.91	−2.21	Citronelle	7.82	2 stations	0.00
Arizona	70.8	+3.2	6 stations	110	[1] 12	Fort Valley	22	1	.12	−.18	Globe	1.32	48 stations	.00
Arkansas	70.9	+1.8	Dumas	96	29	Thornburg	35	15	2.50	−2.52	De Queen	7.48	Mammoth Spring	.61
California	62.8	+1.5	Cow Creek	112	25	Ellery Lake	11	30	.62	−.36	Crescent City (near)	4.62	39 stations	.00
Colorado	56.5	+4.3	Las Animas	100	4	Silverton	12	7	1.73	−.18	Westcliffe	8.14	Rifle	T
Florida	75.7	+.1	Perry	98	10	Quincy	51	5	4.12	+.13	Isleworth	8.56	Cedar Keys	.57
Georgia	73.3	+1.7	5 stations	100	10	Blairsville	35	31	1.22	−2.26	Satilla Forest	4.78	2 stations	.00
Idaho	57.7	+4.8	Orofino	105	26	Pelton Ranch	17	[1] 5	.94	−.74	Bungalow Ranger Station.	3.13	3 stations	T
Illinois	67.4	+4.9	Quincy	95	31	Waukegan	31	14	2.07	−2.05	Le Roy	5.98	Du Quoin	.69
Indiana	65.8	+3.6	Vevay	99	10	Marengo	29	15	2.02	−1.99	Veedersburg	4.63	Vevay	.56
Iowa	66.2	+6.2	3 stations	95	[1] 16	Le Mars	31	3	2.91	−1.16	Marathon	6.63	Cedar Falls	1.05
Kansas	67.7	+3.9	2 stations	99	5	Plainville	36	2	4.88	+1.06	Junction City	10.64	Smith Center	1.60
Kentucky	68.3	+2.9	3 stations	96	[1] 9	Greensburg	35	15	1.50	−2.49	Berea	4.63	Middlesboro	.43
Louisiana	74.0	+.3	do	92	[1] 5	Tallulah	46	31	5.13	+.50	Jennings	15.33	Ruston	1.44
Maryland-Delaware	64.9	+2.5	6 stations	95	[1] 8	3 stations	27	[1] 15	2.11	+1.30	Washington, D. C.	5.32	2 stations	.31
Michigan	58.5	+4.5	Morenci	93	10	2 stations	20	[1] 4	2.11	−1.09	Marquette	5.30	Muskegon	.23
Minnesota	60.5	+5.4	Wheaton	97	31	Cloquet	20	5	2.52	−.63	Winona	6.34	Argyle	.16
Mississippi	73.0	+1.3	Clarksdale	95	16	Pontotoc	42	5	2.69	−1.70	Biloxi	8.70	Eupora	.50
Missouri	68.8	+4.4	5 stations	95	[1] 17	2 stations	32	[1] 3	2.52	−2.25	Oregon	7.10	Fredericktown	.60
Montana	59.0	+7.2	Ballantine	104	26	Conways Ranch	19	21	1.07	−1.11	Belton	3.36	2 stations	.04
Nebraska	64.2	+5.2	Kearney	98	5	Lake Minatare	24	1	3.20	−.25	Hayes Center	9.37	Lake Minatare	.33
Nevada	59.8	+4.4	Logandale	107	[1] 12	San Jacinto	16	6	.45	−.43	Mahoney Ranger Station.	2.94	7 stations	.00
New England	57.6	+2.5	2 stations	97	[1] 8	First Connecticut Lake, N. H.	18	16	2.82	−.50	Fort Fairfield, Maine	6.51	Nantucket, Mass.	.67
New Jersey	63.1	+2.7	Sussex	97	9	3 stations	28	[1] 15	2.78	−.95	Culvers Lake	4.54	Hammonton	.83
New Mexico	61.1	+1.5	Carlsbad	99	5	Lake Alice (near)	13	1	1.78	+.61	Grady (near)	7.19	3 stations	.00
New York	58.9	+3.0	Poughkeepsie	96	8	Gabriels	15	16	2.70	−.78	Trenton Falls	6.00	Brockport	.62
North Carolina	68.7	+1.9	2 stations	98	[1] 19	Banners Elk	30	31	.90	−3.21	Linville Falls	5.24	2 stations	.00
North Dakota	61.0	+8.2	New Salem	100	15	Howard	20	8	.80	−1.60	Edgeley	3.69	Fort Yates	.00
Ohio	64.1	+3.6	2 stations	97	10	Millport	29	15	1.78	−1.87	Alliance	4.08	Portsmouth No. 2	.60
Oklahoma	71.2	+3.0	Hollis	100	17	Kenton	37	8	4.49	−.24	Ardmore	10.96	McAlester	1.12
Oregon	56.6	+3.4	Pendleton	103	26	Austin	19	24	2.09	+.34	Nelscott	8.81	Milton	.07
Pennsylvania	62.8	+3.3	3 stations	96	[1] 8	2 stations	24	15	2.09	−1.79	Matamoras	5.16	McKeesport	.79
South Carolina	72.5	+1.6	Darlington	100	[1] 9	Long Creek (near)	36	31	.48	−3.09	Conway	2.19	7 stations	.00
South Dakota	63.3	+6.8	3 stations	99	[1] 15	Vale	24	2	1.67	−1.21	Sioux Falls	9.03	2 stations	T
Tennessee	69.9	+3.1	Etowah	99	10	Rugby	31	31	1.31	−2.79	Elkmont	3.90	Perryville	.21
Texas	73.5	+.5	Johnson Ranch	105	20	Muleshoe	37	10	6.52	+2.88	Port Arthur	17.88	Clint	.02
Utah	58.9	+3.5	St. George	101	[1] 13	Great Basin Experiment Station.	17	6	.53	−.68	Great Basin Experiment Station.	2.17	Kanab	.00
Virginia	66.3	+2.2	Rocky Mount	97	9	Burkes Garden	29	31	1.35	−2.39	Washington, D. C.	5.32	2 stations	T
Washington	58.6	+4.0	2 stations	103	26	Paradise Inn	23	7	2.70	+.64	Big Four	13.43	Ephrata	.06
West Virginia	64.1	+2.4	Hastings	100	[1] 7	2 stations	25	[1] 15	1.99	−1.98	Elkins	4.30	New Martinsville	.62
Wisconsin	60.4	+5.2	6 stations	92	[1] 15	Long Lake	21	14	2.70	−.88	Wausau	7.26	Plum Island	.48
Wyoming	55.4	+6.0	Basin	99	30	Pole Mountain Nursery.	11	[1] 2	.53	−1.56	Cheyenne	2.90	5 stations	.00
Alaska (April)	30.4	+2.6	Annex Creek	69	24	Barrow	−36	10	1.04	−.37	View Cove	13.22	3 stations	.00
Hawaii	71.0	−.8	Waianae	90	31	Kanalohuluhulu	47	29	9.10	+3.07	Piihonua	64.00	5 stations	.00
Puerto Rico	77.0	+.3	Canauanas No. 2	95	1	Guineo Reservoir	47	12	17.53	+10.98	Rio Grande (La Mina).	40.40	Emsenada	4.05

[1] Other dates also.

TABLE 1.—*Climatological data for Weather Bureau stations, May 1936*

[Compiled by Annie E. Small, by official authority, U. S. Weather Bureau]

District and station	Elevation of instruments: Barometer above sea level	Thermometer above ground	Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Departure from normal	Days with 0.01 inch or more	Wind: Total movement	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles								0-10	In.	In.
New England							56.8	+2.1										71	1.82	-1.4										5.1		
Eastport	76	67	85	29.87	29.95	-0.01	47.6	-0.1	81	18	56	30	16	40	39	44	42	84	2.67	-.3	16	8,199	sw.	33	e.	28	5	9	17	7.1	T	0.0
Greenville, Maine	1,070	6	40	28.78	29.93	----	51.2		84	2	63	22	16	40	47	----	----	----	5.12	----	19	4,565	se.	22	----	16	2	11	18	----	T	.0
Portland, Maine	103	82	117	29.84	29.96	-.01	55.2	+1.9	92	18	64	32	16	46	42	49	43	66	1.41	-2.0	10	7,312	sw.	35	nw.	18	17	11	3	3.9	0.0	.0
Concord	289	60	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
Burlington	403	11	48	29.52	29.96	-.01	57.4	+.9	89	8	68	29	16	47	37	51	45	68	2.88	.0	11	7,651	s.	29	s.	17	3	14	14	6.7	T	.0
Northfield	876	12	60	29.03	29.97	.00	55.8	+3.0	89	8	69	23	16	43	49	50	44	67	1.83	-.9	15	6,128	s.	24	sw.	15	4	16	11	6.7	.0	.0
Boston [1]	29	31	50	29.95	29.98	.00	60.6	+3.5	91	24	71	34	16	50	38	52	46	64	1.70	-1.5	8	8,305	sw.	34	sw.	19	12	10	9	5.0	.0	.0
Nantucket	12	14	90	30.00	30.01	+.02	55.0	+2.7	76	25	61	42	16	49	23	50	46	77	.87	-2.0	7	11,730	sw.	42	sw.	17	14	8	9	4.5	.0	.0
Block Island	26	11	46	29.99	30.02	+.03	54.3	+1.5	72	24	60	40	16	48	20	50	48	82	1.18	-2.3	8	11,365	sw.	33	sw.	17	14	12	5	4.6	.0	.0
Providence	160	215	251	29.84	30.01	+.03	60.0	+1.5	92	24	71	35	16	49	39	52	45	62	1.68	-1.3	10	9,101	nw.	34	nw.	20	17	11	3	3.8	.0	.0
Hartford	159	70	104	29.85	30.02	+.04	61.2	+3.7	91	9	72	37	16	50	38	----	----	----	2.30	-1.2	8	6,759	s.	25	nw.	14	14	13	4	4.1	.0	.0
New Haven	106	74	153	29.92	30.03	+.04	60.5	+2.6	90	24	70	40	15	51	35	53	47	66	1.58	-2.1	8	6,743	s.	25	n.	14	12	14	5	4.3	.0	.0
Middle Atlantic States							64.7	+2.6										63	2.14	-1.3										4.0		
Albany	97	97	112	29.90	30.00	+.02	62.1	+2.8	91	8	73	34	16	51	38	54	47	62	4.20	+1.3	10	6,010	s.	21	sw.	12	9	15	7	5.0	.0	.0
Binghamton	871	57	79	29.13	30.06	+.08	60.2	+2.8	91	11	74	31	15	47	47	----	----	----	2.36	-1.0	10	4,859	nw.	37	w.	18	10	8	13	6.1	.0	.0
New York	314	415	454	29.70	30.03	+.04	62.6	+2.0	90	9	72	43	16	53	29	53	47	65	2.57	-.7	8	11,188	sw.	48	nw.	20	16	10	5	3.9	.0	.0
Harrisburg	374	94	104	29.64	30.04	+.06	65.5	+3.7	92	8	76	39	15	54	35	56	48	58	1.60	-1.8	6	5,571	nw.	35	w.	13	17	11	3	3.4	.0	.0
Philadelphia	114	174	367	29.94	30.06	+.07	65.8	+2.9	93	9	76	45	29	56	32	56	48	59	1.67	-1.6	7	9,868	sw.	34	sw.	13	17	11	3	3.4	.0	.0
Reading	323	283	306	29.69	30.04		65.2	+2.7	91	9	76	40	15	55	31	55	47	56	1.35	-2.3	7	8,018	nw.	41	w.	13	13	16	2	4.0	.0	.0
Scranton	805	72	104	29.18	30.04	+.06	61.8	+2.4	91	11	75	32	15	49	43	53	45	58	2.18	-1.1	8	5,299	sw.	32	nw.	24	14	9	8	4.3	.0	.0
Atlantic City	52	37	172	30.00	30.06	+.06	60.4	+2.3	85	9	68	42	29	53	26	54	50	72	2.47	-.6	7	11,261	s.	36	nw.	14	14	9	8	4.7	.0	.0
Sandy Hook	22	10	57	30.01	30.03	----	61.8	+3.4	89	9	70	45	29	53	33	54	50	71	2.05	-1.7	8	9,420	s.	46	sw.	18	16	10	5	3.4	.0	.0
Trenton	190	88	106	29.84	30.04	----	64.0	+2.9	93	8	76	41	15	52	35	55	48	62	3.50	+.5	7	7,441	s.	35	s.	18	16	10	5	3.8	.0	.0
Baltimore	123	100	215	29.92	30.05	+.06	67.8	+3.4	91	9	78	45	29	58	33	58	51	61	3.18	-.4	6	7,607	s.	32	ne.	27	20	8	3	3.4	.0	.0
Washington	112	62	85	29.94	30.06	+.06	67.4	+3.7	92	8	79	43	15	56	34	57	50	59	5.32	+1.6	6	5,055	nw.	30	w.	3	17	13	1	3.7	.0	.0
Cape Henry	18	8	54	30.05	30.07	----	66.0	+1.8	93	27	74	48	6	58	32	59	55	73	.44	-3.1	3	8,285	se.	36	n.	14	19	11	1	3.2	.0	.0
Lynchburg	686	5	----	29.34	30.08	+.08	68.9	+1.6	95	27	85	38	15	53	43	----	----	----	1.23	-2.4	8	----	s.	----	----	----	5	26	0	----	.0	.0
Norfolk	91	80	125	29.98	30.08	+.08	67.9	+1.7	92	27	78	52	23	58	32	59	54	67	.98	-2.8	5	6,882	se.	25	nw.	19	16	8	7	4.1	.0	.0
Richmond	144	11	52	29.93	30.08	+.09	68.6	+2.1	93	9	81	43	15	56	37	58	52	61	.45	-3.3	3	5,707	sw.	32	nw.	3	21	7	3	2.9	.0	.0
Wytheville	2,304	49	55	----	30.05	+.06	63.2	+1.8	86	10	77	38	31	49	37	----	----	58	.77	-2.9	8	3,953	w.	21	w.	13	17	11	3	----	.0	.0
South Atlantic States							72.1	+1.9										66	1.10	-2.4										3.8		
Asheville	2,253	89	104	27.77	30.07	+.08	66.5	+3.9	89	10	80	43	31	53	41	55	47	55	1.44	-2.0	5	5,125	nw.	21	sw.	11	19	9	3	3.5	.0	.0
Charlotte	779	63	86	29.25	30.07	+.08	72.6	+3.7	93	26	85	50	15	60	30	60	51	51	.01	-3.6	1	5,111	ne.	18	w.	13	18	10	3	3.2	.0	.0
Greensboro	886	6	56	29.13	30.07	----	69.2	----	93	27	84	42	31	55	39	58	51	57	.37	----	6	5,556	sw.	21	nw.	3	18	13	0	3.1	.0	.0
Hatteras	11	5	50	----	30.06	+.05	68.3	-.4	82	25	74	55	16	63	20	----	----	81	2.22	-1.5	9	9,137	ne.	41	nw.	30	17	8	6	----	.0	.0
Raleigh	376	103	146	29.66	30.05	+.06	71.4	+2.9	93	25	83	49	15	60	32	61	54	59	1.13	-2.7	4	6,277	sw.	23	n.	3	20	10	1	3.1	.0	.0
Wilmington	72	73	107	30.00	30.07	+.06	70.6	-.2	95	9	81	53	15	61	34	63	60	73	.20	-3.2	4	6,540	ne.	22	s.	28	17	11	3	3.2	.0	.0
Charleston	48	11	92	30.02	30.06	+.05	73.0	+.3	93	9	80	62	23	66	29	66	64	75	1.79	-1.2	5	7,972	e.	32	e.	22	15	8	8	4.3	.0	.0
Columbia, S. C.	347	67	73	29.69	30.07	+.07	73.8	+1.9	94	10	85	56	7	62	29	62	56	59	.06	-3.0	1	4,944	ne.	17	ne.	21	20	8	3	3.1	.0	.0
Greenville, S. C.	1,039	139	----	----	----	----	73.1	+5.9	94	28	85	54	31	61	32	----	----	----	.15	-3.9	2	----	ne.	----	----	----	19	8	4	----	.0	.0
Augusta	182	62	77	29.85	30.04	+.05	74.6	+2.2	96	10	86	58	7	63	32	64	58	62	.92	-2.1	4	4,315	s.	24	ne.	11	13	12	6	4.1	.0	.0
Savannah	65	73	152	29.98	30.05	+.05	74.6	+1.2	93	9	84	60	5	66	31	67	64	77	1.85	-1.2	7	7,293	e.	37	e.	22	15	7	9	4.4	.0	.0
Jacksonville	43	86	110	29.99	30.04	+.04	74.6	-.4	92	10	83	60	7	67	26	68	65	75	2.38	-1.6	9	6,137	ne.	24	ne.	22	8	13	10	5.7	.0	.0
Florida Peninsula							77.6	+0.3										74	5.06	+0.8										5.0		
Key West	22	10	64	29.92	29.94	-.03	78.6	-0.5	88	29	84	67	4	73	16	72	69	75	3.51	.0	12	7,463	e.	29	w.	30	11	11	9	5.0	.0	.0
Miami	25	124	168	29.94	29.97	-.02	77.0	+.6	88	5	82	66	2	72	19	70	67	72	8.05	+1.8	12	8,604	ne.	37	ne.	23	9	11	11	5.8	.0	.0
Tampa	35	88	197	29.94	29.98	-.01	77.2	+.9	91	14	86	64	1	68	21	69	66	74	3.61	+.6	11	8,864	e.	42	e.	21	13	15	3	4.2	.0	.0
Titusville	43	5	36	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----	----
East Gulf States							74.2	+1.7										67	2.47	-1.4										4.9		
Atlanta [1]	976	5	53	29.03	30.03	+.04	73.0	+3.1	96	10	86	54	31	60	36	61	54	55	.32	-3.2	2	5,342	s.	22	ne.	21	13	14	4	4.2	.0	.0
Macon	370	79	87	29.65	30.04	+.05	74.2	+1.9	97	10	86	52	5	63	36	63	56	58	.30	-2.7	4	4,690	s.	20	nw.	3	18	7	6	3.4	.0	.0
Thomasville	273	49	58	29.74	30.03	+.04	74.3	+.3	94	10	86	57	1	63	31	66	63	73	3.66	.0	9	----	e.	----	----	----	8	12	11	----	.0	.0
Apalachicola	35	11	----	29.97	30.01	----	75.0	----	89	10	82	61	5	69	23	68	----	----	3.25	-.2	4	----	e.	----	----	----	9	14	8	----	.0	.0
Pensacola	56	149	185	29.96	30.02	+.03	73.7	-.2	88	11	79	62	5	68	20	67	64	76	6.13	+2.8	8	8,980	se.	32	se.	26	10	15	6	4.8	.0	.0
Anniston	741	9	----	----	----	----	73.4	+5.0	92	25	87	49	31	60	35	----	----	----	.21	-3.7	4	----	se.	----	----	----	17	12	2	----	.0	.0
Birmingham	700	11	48	29.28	30.03	+.05	74.2	+3.1	90	25	85	52	4	63	32	62	56	59	.65	-3.3	5	4,743	e.	21	se.	11	18	6	7	3.8	.0	.0
Mobile	57	86	105	29.95	30.01	+.02	74.7	+.3	91	11	83	59	5	66	26	67	64	71	3.77	-.6	7	5,399	n.	19	ne.	23	7	17	7	5.5	.0	.0
Montgomery	218	92	105	29.79	30.04	+.05	75.4	+2.0	93	11	85	60	5	66	27	64	59	63	2.22	-1.6	5	4,833	e.	19	e.	21	10	11	10	5.2	.0	.0
Meridian	375	67	92	29.63	30.02	+.04	72.9	+1.6	89	11	83	53	5	63	30	64	60	69	2.48	-1.8	8	4,232	e.	26	s.	16	13	10	8	4.7	.0	.0
Vicksburg	247	65	73	29.77	30.02	+.05	74.1	+1.2	88	21	83	58	15	65	25	65	61	72	2.70	-1.6	9	4,858	e.	21	se.	8	5	13	13	6.2	.0	.0
New Orleans	53	76	84	29.94	29.99	+.02	76.2	+.8	88	13	83	66	7	70	20	68	65	73	3.97	-.6	10	5,301	se.	21	e.	24	7	14	10	6.1	.0	.0
West Gulf States							73.8	+0.5										74	6.79	+2.7										5.8		
Shreveport	249	92	227	29.74	30.01	+.06	74.4	+.8	89	21	84	56	4	65	30	65	60	69	2.69	-1.5	12	7,133	ne.	27	n.	9	8	14	9	5.5	.0	.0
Bentonville	1,303	12	38	28.66	30.01	+.08	68.9	+2.5	86	31	80	46	4	57	35	----	----	----	2.75	----	7	4,556	s.	18	sw.	6	7	16	8	----	.0	.0
Fort Smith	457	79	94	29.52	29.99	+.06	73.1	+3.5	91	31	84	53	4	62	33	62	55	60	1.96	-2.9	7	5,810	e.	22	s.	2	9	15	7	5.1	.0	.0
Little Rock	357	94	102	29.65	30.02	+.07	72.2	+1.9	86	24	81	53	15	63	29	63	58	64	1.24	-3.5	8	5,596	s.	21	se.	17	9	13	9	5.5	.0	.0
Austin	605	136	148	29.31	29.94	----	74.0	-.6	91	18	82	59	11	65	25	67	64	76	8.15	+3.5	13	5,510	se.	27	n.	13	5	14	12	6.4	.0	.0
Brownsville	57	88	96	29.83	29.89	----	76.6	-2.0	91	27	84	63	15	69	21	70	69	85	4.05	+1.8	11	7,047	se.	39	se.	9	8	15	8	5.6	.0	.0
Corpus Christi	20	11	78	29.90	29.92	+.02	76.2	.0	87	19	82	64	11	71	17	71	69	82	5.27	+2.0	13	7,831	se.	38	e.	10	8	8	15	6.1	.0	.0
Dallas	512	220	227	29.41	29.95	----	73.8	----	89	5	82	61	10	66	22	65	61	72	4.12	-.4	12	8,296	e.	35	n.	18	7	12	12	5.9	.0	.0
Fort Worth	679	92	110	29.26	29.97	+.06	74.0	+1.7	90	5	83	59	9	65	25	----	----	----	9.48	+4.8	10	6,442	se.	31	se.	7	12	8	11	5.1	.0	.0
Galveston	54	106	114	29.90	29.96	+.02	75.0	+.2	83	31	80	63	10	71	18	70	68	82	8.90	+5.5	13	8,213	se.	32	se.	24	11	12	8	5.2	.0	.0
Houston	138	292	314	29.82	29.97	----	74.2	-1.3	88	4	81	60	10	67	23	----	----	----	11.55	+7.0	15	8,371	se.	34	e.	23	5	15	11	6.2	.0	.0
Palestine	510	64	72	29.46	29.99	+.06	72.7	.0	87	5	82	58	12	63	25	66	63	78	6.83	+2.3	13	5,334	e.	24	nw.	11	7	10	14	6.2	.0	.0
Port Arthur	34	58	66	29.93	29.97	----	75.2	----	87	21	82	62	10	69	20	----	----	----	17.88	+13.8	15	6,037	e.	27	n.	18	4	18	9	5.9	.0	.0
San Antonio	693	242	301	29.20	29.91	+.01	74.0	-1.1	90	18	82	58	11	66	26	66	64	77	6.13	+2.9	14	7,608	ne.	32	ne.	13	3	12	16	7.2	.0	.0

[1] Observations taken at airport.

TABLE 1.—*Climatological data for Weather Bureau stations, May 1936*—Continued

District and station	Elevation of instruments: Barometer above sea level	Elevation of instruments: Thermometer above ground	Elevation of instruments: Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Pressure: Sea level, reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Temperature of the air: Departure from normal	Temperature of the air: Maximum	Temperature of the air: Date	Temperature of the air: Mean maximum	Temperature of the air: Minimum	Temperature of the air: Date	Temperature of the air: Mean minimum	Temperature of the air: Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Days with 0.01 inch or more	Wind: Total movement	Wind: Prevailing direction	Wind: Maximum velocity: Miles per hour	Wind: Maximum velocity: Direction	Wind: Maximum velocity: Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.	°F.	°F.	°F.			°F.	°F.	°F.	%	In.	In.		Miles									In.	In.
Ohio Valley and Tennessee							67.9	+3.0										57	1.63	−2.1										3.9		
Chattanooga	762	71	214	29.25	30.05	+.06	73.5	+4.7	94	10	86	52	31	61	35	60	52	50	2.06	−1.7	4	4,658	w.	24	nw.	13	18	11	2	3.1	0.0	0.0
Knoxville	995	102	111	29.02	30.06	+.07	72.0	+4.8	94	10	84	49	31	60	34	60	52	54	.76	−3.0	5	3,747	ne.	21	w.	2	19	10	2	2.6	.0	.0
Memphis	399	78	86	29.62	30.04	+.08	73.2	+2.6	90	21	82	52	15	64	26	62	55	57	1.91	−2.3	7	4,968	s.	25	sw.	11	16	9	6	4.2	.0	.0
Nashville	546	168	188	29.50	30.07	+.09	71.3	+3.1	91	25	83	48	4	60	30	60	52	54	1.41	−2.5	4	6,311	w.	24	n.	28	14	12	5	4.0	.0	.0
Lexington	989	6	----	----	----	----	67.8	+3.5	95	9	82	39	15	54	41	----	----	----	1.46	−2.4	7	----	s.	----	----	----	25	3	3	----	.0	.0
Louisville	525	188	234	29.51	30.09	+.11	69.4	+2.8	92	10	80	45	14	59	29	59	51	55	1.09	−2.6	4	6,633	sw.	30	nw.	13	19	9	3	2.7	.0	.0
Evansville	431	76	116	29.60	30.06	+.09	70.5	+3.8	92	25	82	46	14	60	31	60	52	54	1.43	−2.4	5	6,019	s.	31	sw.	12	18	5	8	4.0	.0	.0
Indianapolis	822	194	230	29.20	30.08	+.11	66.2	+3.3	90	9	77	41	14	56	29	56	48	56	1.48	−2.4	6	7,437	s.	29	nw.	13	18	7	6	4.1	.0	.0
Terre Haute	575	96	129	29.44	30.05	----	66.8	----	90	22	80	42	14	57	35	59	52	60	1.59	−2.2	8	6,708	sw.	30	n.	13	17	6	8	4.0	.0	.0
Cincinnati	627	11	51	29.41	30.08	+.09	66.8	+3.7	91	10	79	39	15	55	36	57	51	61	1.04	−2.7	6	4,808	s.	22	sw.	2	19	4	8	3.8	.0	.0
Columbus	900	58	153	29.21	30.08	+.10	65.5	+3.2	94	10	76	39	14	54	32	56	49	59	2.34	−1.2	10	5,950	s.	37	sw.	2	16	8	7	4.1	.0	.0
Dayton	899	137	173	29.13	30.08	----	65.7	+3.1	91	10	77	39	14	54	33	----	----	----	1.04	−2.6	8	5,728	sw.	30	sw.	2	17	6	8	4.0	.0	.0
Elkins	1,947	59	78	28.06	30.11	+.11	60.0	+.8	90	10	74	32	15	46	42	53	48	70	4.30	+.2	10	3,830	n.	29	w.	13	15	7	9	4.5	.0	.0
Parkersburg	637	77	84	29.46	30.11	+.12	65.6	+1.8	93	10	79	40	15	52	38	57	50	61	1.46	−1.9	7	4,056	nw.	23	sw.	2	17	6	8	4.1	.0	.0
Pittsburgh [1]	842	164	410	28.72	30.06	+.07	63.6	+1.2	90	10	75	37	14	52	34	54	46	56	1.01	−2.2	6	7,430	nw.	34	nw.	2	12	12	7	4.8	.0	.0
Lower Lake Region							60.4	+2.9										65	1.70	−1.5										4.9		
Buffalo	768	243	280	29.21	30.04	+.07	53.4	−1.2	82	1	62	32	16	45	36	49	46	78	.92	−2.2	14	10,852	sw.	47	w.	19	12	10	9	5.0	.0	.0
Canton	448	10	61	29.49	29.96	----	56.6	+.4	87	8	68	24	16	45	41	52	47	72	1.83	−1.2	16	7,095	w.	29	sw.	15	5	14	12	6.2	T	.0
Ithaca	836	77	100	29.13	30.03	----	59.8	+2.3	89	11	73	30	16	47	44	53	47	63	3.05	−.4	11	6,198	nw.	25	w.	19	10	14	7	5.1	T	.0
Oswego	335	71	85	29.64	30.01	+.04	56.3	+1.1	84	7	67	32	16	46	41	50	45	67	2.01	−1.0	10	6,802	w.	25	sw.	19	8	11	12	5.5	.0	.0
Rochester	523	86	102	29.47	30.04	+.07	60.2	+3.1	88	8	71	33	16	49	37	52	47	62	1.87	−1.1	14	7,034	sw.	30	w.	19	14	10	7	4.4	.0	.0
Syracuse	596	65	79	29.40	30.05	+.07	61.0	+3.3	89	10	72	32	16	51	41	----	----	----	1.63	−1.4	13	5,912	w.	22	sw.	18	8	13	10	5.7	.0	.0
Erie	714	130	166	29.29	30.06	+.08	61.2	+4.4	85	10	70	39	4	52	33	55	51	72	1.27	−2.1	8	8,653	w.	52	w.	2	17	9	5	4.0	.0	.0
Cleveland	762	267	318	29.25	30.06	+.08	62.6	+4.7	87	10	72	39	4	54	31	54	47	57	2.05	−1.1	7	9,498	sw.	52	w.	2	15	10	6	4.1	.0	.0
Sandusky	629	5	67	29.40	30.08	+.10	63.4	+4.2	90	23	74	40	15	53	36	----	----	----	1.26	−1.9	9	6,260	sw.	26	nw.	13	9	15	7	4.9	.0	.0
Toledo	628	79	87	29.39	30.08	+.11	63.6	+4.2	90	10	74	37	14	53	32	54	48	60	2.00	−1.5	5	6,777	w.	30	nw.	13	13	12	6	4.1	.0	.0
Fort Wayne	857	69	84	29.15	30.07	----	64.2	+4.0	87	10	75	39	14	54	37	55	47	58	1.57	−2.3	8	6,242	sw.	24	nw.	19	16	9	6	4.5	.0	.0
Detroit [1]	626	5	78	29.38	30.06	+.09	62.8	+4.8	90	10	74	37	20	51	38	54	47	60	.97	−2.2	7	7,412	sw.	34	w.	19	12	10	9	5.0	.0	.0
Upper Lake Region							57.0	+4.3										68	2.46	−0.8										5.6		
Alpena	609	13	89	29.36	30.03	+.06	54.7	+4.2	91	7	66	32	20	44	43	46	43	69	2.69	−.4	12	8,336	nw.	37	nw.	13	13	8	10	4.7	.0	.0
Escanaba	612	54	60	29.36	30.02	+.05	52.2	+2.6	84	17	61	32	3	43	34	48	43	75	3.87	+.9	14	8,111	s.	33	ne.	2	8	9	14	6.3	T	.0
Grand Rapids	707	70	244	29.28	30.04	+.07	62.8	+4.8	87	9	74	36	4	51	37	54	47	60	.72	−2.7	7	8,605	sw.	40	sw.	23	10	14	7	4.9	.0	.0
Lansing	878	5	90	29.11	30.04	----	60.7	+3.8	88	10	73	33	20	49	38	54	49	68	.78	−2.6	8	6,697	sw.	27	nw.	13	8	15	8	5.5	.0	.0
Ludington	637	5	54	29.34	30.04	----	55.0	+2.8	79	22	64	30	20	46	28	49	----	----	1.45	−1.6	7	----	s.	----	----	----	14	12	5	----	.0	.0
Marquette	734	77	111	29.20	30.02	+.05	52.0	+3.0	84	7	62	31	3	42	44	46	42	72	5.30	+2.3	15	7,013	nw.	36	s.	22	4	15	12	6.3	.0	.0
Sault Ste Marie	614	11	52	29.32	30.02	+.07	50.8	+1.8	82	7	61	31	20	40	38	45	41	75	3.15	+.1	12	6,607	nw.	32	nw.	13	9	10	12	5.8	T	.0
Chicago	673	7	131	29.34	30.06	+.10	64.4	+6.9	88	9	74	39	3	55	33	55	49	63	2.08	−1.5	11	7,212	sw.	27	sw.	1	12	9	10	5.1	.0	.0
Green Bay	617	109	141	29.34	30.00	+.05	60.6	+5.7	87	7	72	35	3	49	42	53	46	62	1.73	−1.8	11	8,167	s.	32	sw.	23	8	6	17	7.3	.0	.0
Milwaukee	681	97	221	29.30	30.03	+.07	60.7	+6.6	87	7	71	37	3	51	40	52	47	65	2.55	−.8	7	8,626	w.	35	n.	31	8	14	9	5.4	.0	.0
Duluth	1,133	5	47	28.76	29.98	+.02	52.7	+5.4	86	31	64	31	2	42	42	46	41	72	2.70	−.5	14	9,053	ne.	38	nw.	12	8	9	14	6.1	1.2	.0
North Dakota							61.8	+7.8										52	0.65	−1.7										4.0		
Moorhead, Minn.	940	50	58	28.93	29.93	−.01	62.2	+7.1	91	30	75	35	19	49	39	53	46	58	1.22	−1.7	6	6,991	s.	25	nw.	31	10	13	8	5.0	.0	.0
Bismarck	1,674	8	57	28.16	29.92	.00	62.6	+8.1	92	15	77	33	13	49	41	51	40	49	.12	−2.2	3	7,808	se.	31	sw.	21	15	12	4	3.9	.0	.0
Devils Lake	1,478	8 11	44	28.38	29.94	.00	60.3	+7.7	92	30	76	30	13	45	41	50	41	54	.65	−1.4	6	7,690	s.	29	w.	16	15	9	7	4.3	T	.0
Grand Forks	833	12	67	----	----	----	60.9	----	91	30	76	29	13	46	45	52	----	----	1.00	----	5	----	n.	33	s.	5	5	24	2	----	.0	.0
Williston	1,878	42	50	27.94	29.89	−.04	62.1	+8.1	96	15	75	32	1	49	38	50	39	49	.62	−1.4	6	7,891	se.	35	w.	16	22	6	3	2.7	.0	.0
Upper Mississippi Valley							67.4	+5.7										62	1.84	−2.2										5.0		
Minneapolis	919	105	208	29.00	29.98	.00	64.2	+6.5	93	16	74	33	3	54	31	54	47	57	2.25	−1.4	8	7,781	n.	34	w.	31	8	11	12	5.7	.0	.0
La Crosse	714	11	48	29.22	29.98	+.04	65.4	+6.1	90	16	76	39	3	55	33	57	51	64	3.16	−.6	12	4,240	s.	24	sw.	6	9	8	14	5.5	.0	.0
Madison	974	70	78	28.98	30.01	+.05	64.0	+6.4	87	6	74	37	3	54	34	55	49	63	.79	−3.1	8	6,455	sw.	24	sw.	23	9	7	15	6.1	.0	.0
Charles City	1,015	10	51	28.93	30.00	+.06	64.6	+6.8	92	16	76	39	14	53	34	57	51	66	2.28	−2.0	9	5,351	se.	27	sw.	22	12	6	13	5.0	.0	.0
Davenport	606	66	161	29.38	30.03	+.08	67.7	+6.4	91	31	78	42	3	58	32	57	50	60	1.78	−2.2	7	7,320	sw.	32	sw.	6	10	9	12	5.3	.0	.0
Des Moines	861	5	99	29.10	29.99	+.06	68.2	+6.9	92	31	79	43	14	58	32	58	52	60	1.45	−3.1	10	6,925	s.	31	s.	6	12	8	11	5.3	.0	.0
Dubuque	700	60	79	29.27	30.02	+.07	66.4	+6.1	90	31	77	43	3	56	37	56	49	60	1.43	−2.8	7	4,788	s.	22	nw.	1	10	7	14	5.6	.0	.0
Keokuk	614	64	78	29.38	30.02	+.08	68.7	+4.9	90	31	79	46	14	50	33	59	52	60	2.76	−1.2	5	5,574	s.	21	sw.	6	10	11	10	5.2	.0	.0
Cairo	358	87	93	29.67	30.04	+.08	71.6	+3.2	89	26	81	49	4	62	28	62	57	67	1.72	−2.0	7	5,668	s.	40	sw.	12	12	9	10	4.8	.0	.0
Peoria	609	11	45	29.40	30.06	+.10	67.0	+5.3	89	22	79	43	3	55	39	58	52	62	1.72	−2.3	11	4,930	s.	20	w.	1	17	5	9	4.0	.0	.0
Springfield, Ill.	636	5	191	29.37	30.04	+.09	69.2	+6.0	90	22	80	43	14	58	30	59	52	61	1.88	−2.5	9	8,295	s.	28	w.	1	14	9	8	4.6	.0	.0
St. Louis	568	179	303	29.44	30.04	+.09	71.2	+4.2	88	27	81	50	14	62	26	60	54	59	.85	−3.5	7	8,673	s.	43	sw.	9	18	9	4	3.4	.0	.0
Missouri Valley							68.0	+6.0										64	3.30	−0.8										4.8		
Columbia, Mo.	784	6	84	29.20	30.03	+.09	69.7	+5.4	89	31	80	47	3	59	35	----	----	----	2.88	−1.6	8	5,755	s.	22	s.	6	17	12	2	3.9	.0	.0
Kansas City [1]	750	32	45	29.20	30.00	+.08	70.9	+6.1	90	31	81	44	3	60	32	61	55	66	4.16	−.5	10	6,824	sw.	34	sw.	6	8	14	9	5.4	.0	.0
St. Joseph	967	11	49	28.97	29.99	----	69.2	----	89	31	79	43	3	59	30	60	55	68	4.14	−.1	12	6,606	s.	38	nw.	1	16	9	6	4.1	.0	.0
Springfield, Mo.	1,324	98	104	28.64	30.02	+.09	69.0	+4.5	86	31	78	48	3	60	28	60	54	64	2.37	−2.8	10	6,743	s.	26	sw.	1	13	14	4	3.8	.0	.0
Iola	984	11	50	28.97	30.00	+.08	70.2	+5.0	89	31	81	44	3	59	35	----	----	----	4.36	−.3	12	----	se.	----	----	----	7	18	6	----	.0	.0
Topeka	987	65	87	----	----	----	69.8	+5.5	92	31	81	46	2	59	34	----	----	----	4.79	+.3	12	6,494	s.	31	nw.	1	13	12	6	4.5	.0	.0
Lincoln	1,189	11	81	28.71	29.95	+.04	68.2	+6.5	90	16	79	42	3	58	36	58	53	63	1.95	−2.1	9	7,073	s.	39	s.	5	10	11	10	5.5	.0	.0
Omaha [1]	1,105	170	200	28.94	29.97	+.05	68.0	+5.6	94	26	79	35	3	57	37	59	53	64	4.37	+.6	9	7,914	se.	61	nw.	17	10	10	11	5.5	.0	.0
Valentine	2,598	47	54	27.29	29.98	+.08	62.8	+6.6	94	15	75	35	2	51	41	53	45	59	1.87	−1.0	8	7,336	n.	30	sw.	5	9	14	8	5.4	.0	.0
Sioux City	1,138	64	106	28.76	29.95	+.03	67.4	+7.0	92	16	78	37	3	56	38	57	50	60	4.35	+.3	11	7,317	s.	29	sw.	6	8	13	10	5.8	.0	.0
Huron	1,307	59	74	28.58	29.96	+.04	63.8	+7.4	92	5	76	36	3	52	42	56	50	65	1.09	−1.9	8	7,775	se.	29	n.	12	18	10	3	3.7	.0	.0
Northern Slope							59.8	+7.0										50	1.10	−1.2										4.9		
Havre	2,505	11	67	27.27	29.86	−.04	63.4	+10.0	98	27	79	37	23	48	49	48	35	43	.44	−1.6	7	7,094	sw.	32	sw.	20	13	14	4	4.4	.0	.0
Helena	4,124	85	111	25.78	29.92	−.01	58.9	+7.3	90	29	72	35	6	46	43	46	35	47	.89	−1.4	8	7,389	sw.	38	sw.	6	8	12	11	5.9	T	.0
Missoula	3,263	80	91	----	----	----	60.8	+8.0	95	29	75	34	6	47	42	----	----	----	1.54	−.4	12	5,346	se.	31	e.	12	9	9	13	5.9	T	.0
Kalispell	2,973	48	56	----	29.86	−.02	58.9	+7.5	95	27	73	34	7	45	41	----	----	54	.40	−1.1	7	5,408	w.	26	sw.	14	9	13	9	----	.0	.0
Miles City	2,371	48	55	27.40	29.92	+.01	64.6	+7.9	93	28	78	34	8	51	41	51	39	46	1.12	−1.1	6	6,188	se.	34	nw.	15	18	9	4	3.6	.0	.0
Rapid City	3,259	50	58	26.60	29.97	+.07	62.4	+8.4	95	15	75	33	2	50	43	50	40	48	.09	−3.5	2	6,918	s.	27	nw.	21	14	13	4	4.4	.0	.0
Cheyenne [1]	6,094	50	71	23.98	29.92	+.07	55.8	+5.5	81	4	70	30	8	42	38	45	36	57	2.90	+.5	11	8,900	se.	45	nw.	6	6	14	11	5.8	1.8	.0

[1] Observations taken at airport.

TABLE 1.—*Climatological data for Weather Bureau stations, May 1936*—Continued

District and station	Elevation of instruments: Barometer above sea level	Thermometer above ground	Anemometer above ground	Pressure: Station, reduced to mean of 24 hours	Sea level, reduced to mean of 24 hours	Departure from normal	Temperature of the air: Mean max. + mean min. ÷ 2	Departure from normal	Maximum	Date	Mean maximum	Minimum	Date	Mean minimum	Greatest daily range	Mean wet thermometer	Mean temperature of the dew-point	Mean relative humidity	Precipitation: Total	Departure from normal	Days with 0.01 inch or more	Wind: Total movement	Prevailing direction	Maximum velocity: Miles per hour	Direction	Date	Clear days	Partly cloudy days	Cloudy days	Average cloudiness, tenths	Total snowfall	Snow, sleet, and ice on ground at end of month
Northern Slope—Con.	Ft.	Ft.	Ft.	In.	In.	In.	°F.	°F.	°F.		°F.	°F.		°F.	°F.	°F.	°F.	%	In.	In.		Miles									In.	In.
Lander	5,372	60	68	24.65	29.92	+.04	58.3	+7.1	89	30	74	32	17	42	42	44	29	39	0.83	−1.4	4	5,051	sw.	38	sw.	5	12	18	1	4.0	0.0	0.0
Sheridan	3,790	10	47	26.06	29.91		60.0		91	15	77	31	1	43	49	47	35	48	.15	−2.5	3	4,866	nw.	31	nw.	15	15	12	4	4.1	.0	.0
Yellowstone Park	6,241	12	46	23.90	30.01	+.10	51.1	+3.7	85	30	66	28	17	36	40	40	30	51	.61	−1.6	8	6,381	sw.	37	sw.	20	7	19	5	5.4	4.5	.0
North Platte	2,821	11	51	27.06	29.95	+.07	63.8	+5.1	92	15	75	37	2	53	43	54	48	65	3.17	+.4	9	6,227	s.	27	ne.	8	10	14	7	5.5	.0	.0
Middle Slope							66.7	+4.2										61	3.87	+0.5										5.7		
Denver	5,292	106	113	24.74	29.93	+.09	61.3	+5.1	86	5	73	33	7	49	37	48	37	50	1.28	−0.9	10	6,095	s.	30	n.	22	6	16	9	5.6	T	.0
Pueblo	4,685	80	86	25.29	29.91	+.08	63.0	+3.8	89	5	75	36	8	51	35	49	37	49	4.40	+2.8	9	5,766	e.	24	e.	6	8	16	7	5.4	.0	.0
Concordia	1,392	50	58	28.54	29.99	+.08	67.8	+4.6	90	5	78	42	2	58	31	59	54	67	2.86	−1.3	7	6,272	s.	30	sw.	5	10	15	6	5.3	.0	.0
Dodge City	2,509	10	86	27.40	29.97	+.10	67.4	+3.9	94	5	77	44	9	58	34	58	52	66	5.81	+2.9	11	9,646	s.	40	s.	22	11	9	11	5.2	.0	.0
Wichita	1,358	85	93	28.56	29.97	+.07	69.6	+4.5	90	5	79	50	2	61	26	60	55	66	3.30	−1.2	8	7,843	sw.	31	sw.	6	7	11	13	6.2	.0	.0
Oklahoma City	1,214	10	47	28.71	29.97	+.08	71.2	+3.5	89	5	80	54	10	62	25	62	58	69	5.56	+.7	11	6,793	s.	28	se.	6	8	5	18	6.6	.0	.0
Southern Slope							71.2	+0.6										63	4.68	+2.0										5.8		
Abilene	1,738	10	52	28.15	29.93	+.06	73.6	+1.6	93	18	84	54	9	63	30	63	58	67	3.75	−.2	10	6,673	se.	30	se.	7	9	12	10	5.6	.0	.0
Amarillo	3,676	10	49	26.28	29.95	+.11	67.0	+2.9	91	5	77	43	9	57	36	56	49	63	9.02	+6.2	13	7,135	s.	27	e.	20	7	12	12	6.1	.0	.0
Del Rio	960	63	71	28.89	29.86	+.01	75.6	+1.4	91	18	86	60	19	65	30	66	61	68	3.72	+.8	12	7,080	se.	43	n.	19	7	15	9	6.2	.0	.0
Roswell	3,566	75	85	26.34	29.89	+.07	68.5	−.9	93	5	81	41	8	56	39	56	47	55	2.21	+1.1	8	6,539	s.	32	sw.	7	12	11	8	5.2	.0	.0
Southern Plateau							68.5	+3.5										36	0.38	−0.1										3.4		
El Paso	3,778	82	101	26.13	29.82	+.04	74.2	+2.7	95	20	86	49	8	62	30	55	38	34	.56	+.2	2	6,703	se.	32	se.	3	19	9	3	3.2	.0	.0
Albuquerque	4,972	5	39	25.02	29.82	------	65.0	+1.7	90	20	81	37	8	49	41	49	36	44	.27	−.3	6	7,189	n.	36	w.	26	8	12	11	5.6	T	.0
Santa Fe	7,013	38	53	23.28	29.85	+.04	59.0	+3.3	79	4	71	31	8	47	31	45	34	47	1.75	+.5	8	5,083	e.	21	se.	7	10	13	8	5.3	3.0	.0
Flagstaff	6,907	10	59	23.35	29.83	+.05	53.2	+2.5	81	24	72	26	1	35	46	38	----	37	.09	−1.1	1	6,770	nw.	28	sw.	31	12	13	6	----	T	.0
Phoenix	1,108	10	107	28.63	29.76	−.02	81.7	+6.7	106	25	98	55	7	65	41	56	32	22	T	−.1	0	4,990	e.	26	n.	6	23	7	1	1.9	.0	.0
Yuma	141	9	54	29.62	29.76	−.03	80.6	+4.4	107	11	98	56	1	63	45	59	40	32	.0	.0	0	4,471	w.	32	n.	6	27	4	0	1.0	.0	.0
Independence	3,957	5	26	25.90	29.88	+.04	66.0	+3.0	91	24	82	41	1	49	39	46	----	----	.0	−.2	0	------	n.	----	----	----	27	4	0	----	.0	.0
Middle Plateau							60.2	+4.2										36	0.20	−0.8										3.0		
Reno	4,527	61	76	25.46	29.92	+.01	57.6	+3.4	87	25	72	33	30	43	40	44	31	43	T	−.6	0	5,943	w.	30	w.	28	20	10	1	2.6	.0	.0
Tonopah	6,090	12	20	------	------	------	60.0	------	82	25	73	32	6	47	40	42	24	31	T	------	0	------	se.	----	----	----	----	----	----	----	----	----
Winnemucca	4,344	18	56	25.58	29.93	+.02	58.5	+4.6	93	25	76	30	7	42	46	44	30	43	.29	−.6	5	6,019	ne.	32	nw.	5	18	10	3	3.2	T	.0
Modena	5,473	10	46	24.58	29.84	+.02	57.2	+3.7	85	25	75	29	1	40	45	41	22	30	.10	−.7	2	8,441	sw.	41	s.	19	16	11	4	3.2	T	.0
Salt Lake City [1]	4,357	86	210	25.68	29.88	+.02	61.8	+4.4	89	26	78	34	22	46	46	47	33	42	.35	−1.6	3	8,062	se.	54	w.	19	18	7	6	3.1	T	.0
Grand Junction	4,602	60	68	25.33	29.86	+.03	65.9	+4.8	91	29	80	36	9	52	38	47	27	30	.24	−.6	4	5,701	se.	27	sw.	15	17	10	4	3.1	.0	.0
Northern Plateau							62.0	+5.8										46	0.58	−0.8										4.6		
Baker	3,471	48	53	26.42	29.98	+.02	57.4	+5.7	91	26	72	33	17	43	43	47	37	54	.69	−.9	6	4,615	se.	20	n.	6	11	11	9	5.0	T	.0
Boise	2,739	79	87	27.11	29.94	.00	62.8	+5.7	95	26	76	35	6	49	37	50	38	46	.69	−.7	3	4,734	nw.	22	nw.	5	13	11	7	4.4	T	.0
Pocatello	4,477	60	68	25.44	29.91	+.02	59.5	+5.7	89	26	74	32	6	45	40	45	30	39	.71	−.8	6	7,115	se.	31	sw.	19	15	11	5	3.7	T	.0
Spokane	1,929	101	110	27.90	29.92	−.04	62.0	+6.5	93	26	75	40	6	49	40	49	38	47	.57	−.8	8	5,716	s.	31	s.	27	12	12	7	5.1	.0	.0
Walla Walla	991	57	65	28.87	29.93	−.03	65.8	+6.2	99	26	78	43	6	54	41	52	40	44	.49	−1.1	8	5,029	sw.	25	w.	5	9	16	6	4.7	.0	.0
Yakima	1,076	58	67	28.79	29.93	------	64.2	+5.2	97	26	77	37	20	52	39	51	38	43	.32	−.3	6	5,866	nw.	24	w.	5	10	12	9	5.0	.0	.0
North Pacific Coast Region							57.3	+3.7										74	3.36	+1.0										6.9		
North Head	211	11	56	29.81	30.04	+.01	53.1	+2.2	76	12	58	43	17	49	26	51	48	87	4.42	+1.5	16	12,681	nw.	49	s.	4	3	7	21	7.6	.0	.0
Seattle	125	90	321	29.87	30.00	−.01	59.0	+4.5	82	25	68	43	7	50	30	52	46	68	3.29	+1.4	17	6,845	n.	28	s.	5	7	9	15	6.4	.0	.0
Tatoosh Island	86	10	54	29.92	30.02	+.01	52.4	+2.8	70	12	56	44	9	49	20	50	47	86	4.33	+.3	16	9,317	s.	40	s.	18	0	5	26	8.7	.0	.0
Medford	1,329	29	58	28.59	29.98	------	61.2	------	97	25	76	35	7	46	50	51	44	65	1.62	+.4	15	------	nw.	----	----	----	11	13	7	----	T	.0
Portland, Oreg	153	68	106	29.84	30.00	−.03	61.2	+4.3	89	12	71	41	7	52	35	53	47	66	3.72	+1.5	16	5,164	nw.	26	sw.	14	8	7	16	6.2	.0	.0
Roseburg	510	45	76	29.47	30.02	−.01	60.8	+4.8	90	10	74	38	7	48	40	52	47	69	2.78	+.8	14	3,745	n.	24	sw.	18	8	8	15	5.7	.0	.0
Middle Pacific Coast Region							62.9	+3.3										62	1.03	−0.2										4.9		
Eureka	62	73	89	29.97	30.04	−.01	55.6	+3.6	74	13	62	43	7	50	20	52	49	83	2.23	+.4	13	6,629	n.	30	s.	27	10	11	10	5.1	.0	.0
Redding	722	20	34	------	------	------	68.0	+1.6	99	25	80	44	6	56	34	54	41	45	.72	−.8	7	6,725	nw.	27	nw.	19	16	6	9	4.3	.0	.0
Sacramento	66	92	115	29.86	29.93	−.01	66.6	+3.3	98	23	79	45	20	54	36	54	44	52	.68	−.1	3	6,159	sw.	27	nw.	6	19	9	3	2.6	.0	.0
San Francisco	155	208	243	29.81	29.98	−.01	61.5	+4.7	85	8	68	50	24	55	27	54	48	69	.49	−.3	6	7,108	w.	30	n.	6	15	10	6	4.0	.0	.0
South Pacific Coast Region							66.5	+3.1										62	0.01	−0.4										3.4		
Fresno	327	97	105	29.56	29.91	−.01	70.7	+3.6	100	23	85	47	20	56	36	55	42	45	.04	−.4	1	5,682	nw.	30	nw.	6	21	7	3	2.6	.0	.0
Los Angeles	338	159	191	29.57	29.93	−.02	65.6	+3.4	83	9	74	53	30	57	25	57	51	67	.00	−.4	0	4,446	sw.	16	w.	28	19	9	3	3.0	.0	.0
San Diego	87	62	70	29.84	29.93	−.02	63.2	+2.4	76	8	69	53	7	58	23	57	54	75	T	−.4	0	5,473	w.	20	nw.	14	15	8	8	4.5	.0	.0
West Indies																																
San Juan, P. R	82	9	54	29.82	29.90	------	79.4	+.8	90	29	84	71	11	74	16	----	----	----	16.88	+11.6	23	6,200	se.	25	e.	1	2	17	12	6.7	.0	.0
Panama Canal																																
Balboa Heights	118	6	92	------	[3]29.80	−.02	81.0	+.3	92	1	87	73	1	75	19	----	----	[2]85	6.36	−1.5	16	3,809	nw.	23	nw.	2	0	22	9	6.9	.0	.0
Cristobal	36	6	97	------	[3]29.81	−.03	81.5	+.8	92	28	86	74	4	77	12	77	76	[2]84	12.86	+.3	21	4,994	n.	23	n.	4	0	13	18	8.0	.0	.0
Alaska																																
Fairbanks	454	11	87	------	------	------	------	------	----	----	----	----	----	----	----	----	----	----	------	------	----	------	----	----	----	----	----	----	----	----	----	----
Juneau	80	96	116	[3]29.85	[3]29.94	------	48.0	------	79	31	55	32	2	41	35	43	38	71	5.59	------	22	4,566	s.	24	se.	23	5	2	24	7.8	.0	.0
Hawaiian Islands																																
Honolulu	38	86	100	[3]30.03	[3]30.07	------	73.4	−1.4	81	30	77	66	11	70	11	66	62	69	1.60	−.2	18	8,529	e.	30	ne.	17	5	17	9	6.0	.0	.0

[1] Observations taken at airport.
[2] Observations taken bihourly.
[3] Pressure not reduced to mean of 24 hours.

TABLE 2.—*Data furnished by the Canadian Meteorological Service, May 1936*

Station	Altitude above mean sea level, Jan. 1, 1919	Pressure: Station reduced to mean of 24 hours	Pressure: Sea level reduced to mean of 24 hours	Pressure: Departure from normal	Temperature of the air: Mean max.+mean min.÷2	Temperature of the air: Departure from normal	Temperature of the air: Mean maximum	Temperature of the air: Mean minimum	Temperature of the air: Highest	Temperature of the air: Lowest	Precipitation: Total	Precipitation: Departure from normal	Precipitation: Total snowfall
	Feet	In.	In.	In.	°F.	°F.	°F.	°F.	°F.	°F.	In.	In.	In.
Cape Race, Newfoundland	99				39.5		44.9	34.1	59	26	7.09		0.0
Sydney, Cape Breton Island	48	29.88	29.93	−0.04	46.7	+1.5	57.2	36.3	75	25	4.38	+0.61	.0
Halifax, Nova Scotia	88	29.71	29.81	−.17	48.7	+.3	56.7	40.8	78	33	3.51	−.75	.6
Yarmouth, Nova Scotia	65	29.85	29.92	−.06	48.9	+1.3	56.2	41.7	67	32	1.47	−2.10	.1
Charlottetown, Prince Edward Island	38	29.85	29.89	−.07	47.3	+.4	55.8	38.8	70	28	5.53	+2.62	.5
Chatham, New Brunswick	28	29.80	29.83	−.12	47.3	−1.2	57.4	37.2	74	26	3.69	+.48	2.2
Father Point, Quebec	20	29.85	29.87	−.06	42.5	−1.5	49.4	35.5	64	28	3.71	+1.13	.0
Quebec, Quebec	296	29.56	29.89	−.05	49.8	−.1	58.2	41.4	78	29	5.16	+2.08	T
Doucet, Quebec	1,236				42.9		54.7	31.2	82	14	5.34		5.1
Ottawa, Ontario	236	29.69	29.95	+.01	55.8	+.9	66.6	44.9	89	26	2.38	−.21	.0
Kingston, Ontario	285	29.67	29.98	+.02	53.7	+.8	62.7	44.7	78	28	2.04	−.64	.0
Toronto, Ontario	379	29.61	30.01	+.03	58.7	+5.5	70.1	47.3	90	32	.72	−2.32	.0
Cochrane, Ontario	930				43.0		53.2	32.8	81	18	3.49		4.0
White River, Ontario	1,244	28.67	29.99	+.04	46.1	+.4	57.9	34.4	78	20	2.79	+.84	T
London, Ontario	808				57.5		69.4	45.6	85	31	1.10		.0
Southampton, Ontario	656	29.31	30.03	+.07	53.1	+2.4	64.1	42.1	81	28	.83	−1.61	.0
Parry Sound, Ontario	688	29.30	30.00	+.05	53.1	+2.0	64.1	42.2	82	26	1.92	−1.01	.1
Port Arthur, Ontario	644		30.01	+.05	46.8	+.9	57.7	35.9	73	22	2.74	+.50	.0
Winnipeg, Manitoba	760	29.11	29.93	−.03	57.5	+5.9	71.2	43.8	93	29	.94	−1.34	T
Minnedosa, Manitoba	1,690	28.14	29.94	−.02	55.8	+7.4	69.6	41.9	90	26	.75	−.70	.0
Le Pas, Manitoba	860				49.8		61.7	37.8	93	22	1.10		1.7
Qu'Appelle, Saskatchewan	2,115	27.64	29.86	−.08	55.4	+5.6	69.8	41.1	94	24	1.72	+.07	.0
Moose Jaw, Saskatchewan	1,759				58.4		72.0	44.9	97	32	3.31		T
Swift Current, Saskatchewan	2,392	27.34	29.82	−.10	59.8	+9.1	73.9	45.7	97	33	1.21	−.55	.0
Medicine Hat, Alberta	2,365	27.39	29.84	−.05	61.6	+7.5	75.3	48.0	97	38	.83	−.48	.0
Calgary, Alberta	3,540	26.26	29.89	+.01	55.8	+6.8	69.3	42.4	88	28	2.16	+.39	T
Prince Albert, Saskatchewan	1,450	28.38	29.94	−.01	56.1	+8.5	69.0	43.3	96	30	.67	−.59	.0
Battleford, Saskatchewan	1,592	28.16	29.88	−.04	58.7	+7.7	73.0	44.5	101	32	.45	−1.17	.0
Kamloops, British Columbia	1,262	28.62	29.89	.00	62.6	+3.5	76.3	48.9	99	38	1.28	+.04	.0
Victoria, British Columbia	230	29.75	30.00	.00	54.6	+2.1	61.4	47.9	74	42	1.68	+.20	.0
Estevan Point, British Columbia	20				51.5		56.3	46.7	61	38	5.63		.0
Prince Rupert, British Columbia	170				47.8		55.4	40.2	71	32	9.08		.0

SEVERE LOCAL STORMS, MAY 1936

[Compiled by Mary O. Souder from reports submitted by Weather Bureau officials]

[The table herewith contains such data as have been received concerning severe local storms that occurred during the month. A revised list of tornadoes will appear in the Annual Report of the Chief of Bureau]

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Eskridge, Kans., 8 miles north	1	2 a. m.			$1,000	Wind	Large barn and several small farm buildings blown down; path 1½ miles long.
Chicago, Ill.	1	12:14 p. m.		1		Thunderstorm	Streets and underpasses flooded; some damage by lightning.
Garfield County, Okla.	1	2:40–5:10 p. m.	[1] ⅛–3		2,500	Hail	Storm path ran through Enid and Waukomis; estimated damage in former city $2,500; gardens ruined, windows broken, roofs damaged and crops, especially wheat, beaten down; path 15 miles long.
Albert, Okla.	1	6:45 p. m.	440	3	40,000	Tornado	11 persons injured; 4 rural homes completely destroyed loss to crops $5,000; property damage $35,000; path 2 miles long.
Knox City, Tex.	1	10 p. m.	[1] 2		25,000	Hail	Roofs damaged.
Pleasant Plains, Ill., vicinity of.	1				10,000	Wind	Property damaged.
Detroit, Mich.	2	12:45 p. m.	2,640	2		Thundersquall and hail	In less than 2 hours 0.58 inch of rain was recorded; hail fell in the northwest and northern section of Detroit eastward over lakes St. Clair; in Detroit only few windowpanes were damaged, but flower gardens were ruined; heavy hail damage reported along Lake St. Clair, and 3 boys injured by hail. A branch of the storm cut southeastward and struck over the Windsor, Ontario, section, with considerable damage, several roofs blowing off; trees and telephone poles down. 2 men drowned when their boat capsized in the Detroit River near Trenton, Mich.
Sapello (near), N. Mex.	3	2 p. m.	200	0		Tornado and hail	2 houses and 7 outbuildings destroyed; hail accompanied the storm over an area ½ to 2 miles wide and nearly 40 miles long, covering the ground with an average depth of 4 inches.
Chamberino to La Union (near) N. Mex.	3	7:30 p. m.	2,640		25,000	Hail	Man seriously injured; loss to crops; many roofs damaged.
Mescalero, N. Mex.	3	8 p. m.				do.	About two-thirds of fruit on trees lost.
Havre, Mont., vicinity of.	4	5:30–6 p. m.	[1] 2–3		500	Wind	Barn wrecked.
Plevna, Mont., 2 miles south.	5	5:20 p. m.	50–100	0	200	Tornado	Several small buildings wrecked; path short.
West Bend, Wis., and vicinity.	6	5:30 a. m.				Thundersquall	2.51 inches in 2¼ hours recorded; heaviest rainfall in Washington County since the disastrous flood of 1924; heavy damage to roads; roofs of barns blown off and hayrack demolished; many thousand dollars' loss to newly seeded fields; some so severely rutted that replanting will be necessary.
Lincoln County, Wis., southern portion.	6					Heavy rain, electrical.	A cloudburst, accompanied by one of the most violent electrical storms in recent years, flooded roads over a wide area causing severe washouts along the Milwaukee road; many communication and power lines out of commission because of lightning. All creeks in the Corning, Scott and Pine River sections swollen; bridges and culverts flooded and tracks at numerous points washed out; passengers, mail and express were transferred from Wausau to Merrill by automobile and truck. All available section workers required to repair damage and restore service as soon as possible. One side of the South Foster street bridge collapsed under the rush of water which swept over the street to the north for about 2 blocks.
Ransom, Kans.	7	4 p. m.			200	Wind	Small buildings damaged; trees broken off.

SEVERE LOCAL STORMS, MAY 1936—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Garden City to Kalvesta (near), Kans.	7	5 p. m.	100	0	$1,500	Small tornado	Originated 5 miles southeast of Garden City and ended near Kalvesta. Several funnel clouds seen near point of origin. Chief damage to small buildings near Garden City; path 30 miles long.
Gretna (near), Kans	7	8 p. m.			1,000	Wind	Damage only to 1 farm.
Ransom, Kans	7	do	33	0	800	Small tornado	Several outbuildings, chicken houses and garage blown over; some damag to larger buildings; path 2 miles long.
Atoka, Okla., 7 miles northwest.	8	4:10 p. m.	100	0	$25,000	Tornado	1 person injured; large country home, built of native rock, completely demolished.
Hanna, Okla	8	do		1	40,000	Tornado and rain	29 persons injured, 4 seriously; 15 homes destroyed and 5 damaged. While 2 local physicians worked over the injured, 2 ambulances from Eufaula were floated twice across flooded Mill Creek to remove the seriously injured to a hospital at Henryetta. Farmers, busy removing livestock from barns in the creek bottom, deserted their interests to help the ambulances across.
Ashland, Okla	8	5 p. m.	440	0	7,000	Tornado	2 persons injured; 12 houses and a church badly damaged.
Bonham, Tex	8	do	440	1	15,000	do	5 persons injured; property damaged.
Grove, Okla	8	8 p. m.	100	1	15,000	do	12 persons injured; several homes and outbuildings in the southern portion of town wrecked; path several miles long.
Webbers Falls, Okla	8	8:15 p. m.	100	0	21,000	do	100-foot steel bridge wrecked; property damaged; path 8 miles long.
Gore, Okla	8	P. m.		0		do	6 persons injured, family of 4 injured by flying glass when their home was demolished; houses and outbuildings along the south edge of town wrecked.
Pursley, Tex	8			0		do	No serious damage reported.
Horatio, Ark., 3 miles southeast.	9	2 p. m.	880	2	20,000	do	20 persons injured; path 10 miles long.
Ozan, Ark., 2½ miles east	9		150	0	500	do	Property damaged.
Southern Colorado and northern New Mexico.	9					Blizzard	11 to 24 inches of snow in 12 hours recorded; snowdrifts, from 3 to 5 feet deep; 150 motorists, including 45 passengers in 2 transcontinental buses entrapped on top of Raton Pass; telephone poles and trees down. Trinidad, Colo., and outlying sections isolated.
Marion, S. C., vicinity of	9				1,500	Thundersquall	Damage confined mostly to roofs and chimneys.
Texas, eastern portion	9			6	975,000	Tornadoes, heavy rain and hail.	Crops ruined, in some areas fruit was stripped from trees; much livestock killed or crippled. At least 20 bridges destroyed and railroad schedules interrupted because of track damage. Twisters struck near Lindale, Corsicana, Bonham, and Omaha. Heaviest rain at Tyler, Tex., 7 inches having fallen by noon; soaking rains reported from Longview, Athens, Marshall, Clarksville, Sulphur Springs, Omaha, Ennis, Paris, and surrounding areas. Heavy hail damaged crops and residences in the vicinity of Waco, where hailstones were described as large as hen eggs. The tornado that struck the Tyler area was first reported at Mount Sylvan about midnight where several small houses and barns were destroyed and trees uprooted; 2 miles east of Lindale a 7-room house was blown 30 feet from its foundation. At Omaha, 2 persons were injured when their new home was demolished and they were blown across the highway and found lying on top of a neighbor's roof. In Athens, Tex., railway traffic was halted on 1 line and many bridges and culverts washed out; streets damaged and heavy losses sustained by farmers in one of the heaviest rains in the history of Henderson County. Traffic was halted on many country roads and activity in the Cayuga oil field area was held up after a large steel bridge between the field and Palestine had been washed out.
Milwaukee, Wis	10					Electrical	Six places struck by lightning; an electrical transformer put out of commission, disrupting service in its vicinity. Roof of a church and a chimney of a residence struck by lightning.
Dodge City, Kans., 2 miles north.	11	11:12–11:45 a. m.		0		Small tornado	Whirling cloud did not reach the ground; no damage reported.
Madill, Okla	11	12:05 p. m.	[1] 5		5,500	Hail	Loss to crops $5,000; property damage $500.
Minneola (near), Kans	11	5 p. m.		0		Small tornado	Whirling cloud did not reach the ground; no damage reported.
Randolph and Clay Counties, Ark.	12		[1] ½–3		55,000	Wind and hail	Several houses and barns destroyed by wind in Shannon, Randolph County; property damage $5,000; loss to crops from hail $50,000.
Essex, Mo., and vicinity	12				75,000	Heavy wind and hail.	Loss to cotton, corn, and gardens by hail, $50,000; property damage from wind $25,000.
Silverhill (near), Ala	13				6,000	Heavy hail	Loss to crops.
Portland. Oreg	13					Thundersquall	Lightning and wind caused damage to electric wires: trees blown down; traffic interrupted.
Trempealeau County, Wis., northern portion.	16	Midnight	325	0	30,000	Tornado	Destruction confined to 2 areas each from 2 to 3 miles long in Hale and Chimney Rock; 6 barns completely destroyed and 6 others damaged; many small buildings wrecked or damaged.
Omaha, Nebr	17	3:08–4 p. m	[1] 10		80,000	Wind, hail, and rain.	Storm, extremely severe and one of the worst of its kind ever experienced, extended from the Municipal Airport westward beyond Fort Omaha and northwestward to Florence. The storm area stretched out with less severity as far west as Irvington and to the north of Florence; 60-mile wind and excessive hail and precipitation recorded; several houses blown off their foundations, one totally destroyed. Number of roofs blown off or badly damaged; trees uprooted. No funnel-shaped cloud positively seen. A major feature of the storm was a freshet in the hill district west and north of Fort Omaha, which sent a wall of water through the Fort carrying enormous quantities of hail and debris with it. Parks, streets, basements, first floors of residences, and stores were flooded; 6,000 claims for insurance filed.
Cottonwood, Iowa	17	5 p. m.			1,000	Electrical	Small railroad station destroyed after being struck by lightning.
Clay County, Kans., northern portion.	17	9:30 p. m.	[1] 1		15,000	Heavy hail	Hail thick on ground the following day; wheat, oats, and gardens ruined; path 12 miles long.
Junction City, Kans., vicinity of.	17	10:30 p. m.	[1] 3		20,000	do	Loss to crops, path 4 miles long.
Council Bluffs, Davenport, and Clinton, Iowa.	17					Wind, rain, and hail.	Indian Creek, scene of a $1,600,000 flood-control project, in Council Bluffs, suffered unestimated damage; 2.26 inches of rain fell. Water carried heavy trees and debris down the channel destroying ironwork placed as a base for the concrete in construction work; all 6 of the temporary dams in the creek were carried away. More than 1,000 panes of glass in 1 greenhouse broken and 275 homes without telephone service. Clinton, Iowa, across the State from Council Bluffs, described this storm as the worst in recent years; in the residential district the street lighting system was out of commission; traffic interrupted and many trees uprooted. In Davenport, rain measured 0.74 inch and no serious damage reported; several minor automobile accidents due to blinding rain; some windows broken and communication service disrupted for an hour.
Jo Daviess, Carroll, Ogle, Whiteside, Lee, and McDonough Counties, Ill.	17					Hail	Several thousand dollars damage to windows and roofs; loss to crops.
Milledgeville (near), Ill	17				5,000	Wind	Property damaged.
LaFayette, Green, and Rock Counties, Wis.	17				85,000	Wind and hail	Several barns and smaller buildings damaged or wrecked by wind to the extent of $20,000; property damage from hail in LaFayette, Green, Rock, Milwaukee, and Racine Counties $55,000; crop loss $10,000.
Dickinson County, Kans., northern portion.	18	1 a. m.	[1] 1		1,000	Heavy hail	Path of storm 5 miles long; no details.

SEVERE LOCAL STORMS, MAY 1936—Continued

Place	Date	Time	Width of path, yards	Loss of life	Value of property destroyed	Character of storm	Remarks
Hillsborough, N. J	18	7:30 p. m.		0		Tornado	A farmer observed, from a window in his house, a freak tornado which lifted his barn containing a mowing machine, 2 wagons, several plows, a hay-rack, and 8 chickens, 50 feet in the air and dropped it, as flat as a pancake, 100 yards from its foundation. Other farm buildings were not damaged. An automobile, parked as close as possible to the barn to protect it from the rain, was untouched; 8 fruit trees near the barn uprooted. This tornado streaked directly across the Huff farm and disappeared as suddenly as it came, no other farm in this district being affected.
La Grange and Wappingers Falls, N. Y.	18				$10,000	Hail	Loss to apple crop.
Syracuse, N. Y	19	3:31-3:35 p. m.				Wind and hail	Several shade trees and electric transmission lines blown down.
Cohoes, N. Y	19	4:40 p. m.		0		Tornado	A waterspout, after passing over the Hudson River, took on tornadic character in north Troy. Roofs were torn from 2 sheds of an ice plant, 1 roof being found across the dyke on Green Island, about 500 feet away. Residents who saw the tornado said that low-hanging clouds from the northwest seemed to meet over the south end of the city. Immediately there appeared a funnel-shaped cloud moving fast toward the east.
Germantown, N. Y	19				10,000	Hail	Loss to fruit crop.
Aulander, N. C	19			1		Thunderstorm	Lightning struck a steam boiler in a sawmill causing an explosion, instantly killing 1 man and seriously injuring 4 others.
Wagner, S. Dak	21-22	6 p. m.			500	Wind, electrical, and rain.	Storm started during the evening of the 21st, and after 2.75 inches of rain fell, subsided until 2:30 p. m., of the 22d when it rained again, bringing the amount to 5.56 inches by 6 p. m. The recently completed earth and stone dam at Lake Wagner broke, tearing a 50-foot hole at the deepest part of the lake where the dam is 30 feet thick and 25 feet high. Large barn, several brooder houses and small garage destroyed; much crop loss; many farmers must replant corn as the seeds were washed out or covered with mud. Path narrow.
Stuart, Fla	21-23					Squalls	Several boats beached and several sunk.
Sioux City, Iowa	22	9 a. m.		1		Thunderstorm	1.76 inches of rain recorded in 2 hours; a workman killed and 7 others injured.
Charles City, Iowa	22	1:20-6:40 p. m.				Thundersquall	Shade trees and poles blown down; minor damage to buildings.
Dodge City, Kans., 6 miles east.	22	2 p. m.		0		Tornado and dust.	Dense dust was seen as the cloud reached the ground; no damage reported.
Turner County, S. Dak	22	3-4 p. m.	440	0	3,000	Tornado	4 distinct tornado funnels observed about 5 miles south of Parker; several small buildings demolished; trees uprooted; path 10 miles long.
Frankfort, Kans., 5 miles west	22	4 p. m.	20	0		do	Number of small buildings blown down; damage not estimated; path 1,320 yards long.
Wambles, S. Dak., vicinity of	22	do	[1] 3		500	Wind	Several small buildings and windmills destroyed.
Menno, S. Dak	22	P. m.			5,350	Wind and rain	Property damaged; loss to livestock.
Sioux Falls, S. Dak., vicinity of.	22	do				Heavy rain	Some fields inundated necessitating replanting of crops.
Cheyenne, Wyo	22					Heavy hail	Depth of hail on the ground measured from 1 to 4 inches. In a southerly direction, this storm, extended along a path 2 miles wide into Colorado.
Jennings and Jefferson Counties, Ind.	25	3:30 p. m.			6,000	Wind and hail	Loss to crops $6,000; property damaged; chickens and young livestock killed.
Orleans, Ind., 3 miles northeast.	25	4:30 p .m.			150,000	do	Crop loss; trees; trees in 2 large apple orchards stripped.
Pensacola, Fla	27	3:45 p. m.	17	0	200	Tornado	Storm appeared first as a waterspout over east Pensacola Bay; funnel-shaped cloud, poorly defined and of dark grey color, was attended by light rain and a slight roaring sound; the debris and trees were mostly in a northeast-southwest direction.
Mountain Park, N. Mex	29	5:30 p. m.	[1] 2		1,000	Heavy hail	Loss to cherry and apple crop.
Cowles, N. Mex	29	6:30 p. m.				do	Automobile tops damaged. Crops not far enough advanced for loss.
Lamar, Carlton, and Holly, Colo.	30			5	478,500	Excessive rain and flood.	As a result of heavy downpours in the extreme lower Arkansas River Valley, flood stages occurred in the Arkansas River from the vicinity of Lamar to that of Holly; 5 persons were drowned; $397,500 damage to highways, bridges, etc.; $20,000 to matured crops; $50,000 to prospective crops, involving 4,000 acres; and $11,000 livestock loss.
Socorro, N. Mex	31	2 p. m.		1		Wind	Roof of porch torn down and piece of metal roofing struck a man in the neck causing instant death.
LATE REPORT APRIL 1936							
Cheyenne County, Kans., northwestern portion.	30	3:30 p. m.	5		$5,000	Heavy hail	Hailstones drifted to depth of 10 feet in places and not melted after several days; too early for much crop loss.

[1] Miles instead of yards.

Chart I. Departure (°F.) of the Mean Temperature from the Normal, May 1936

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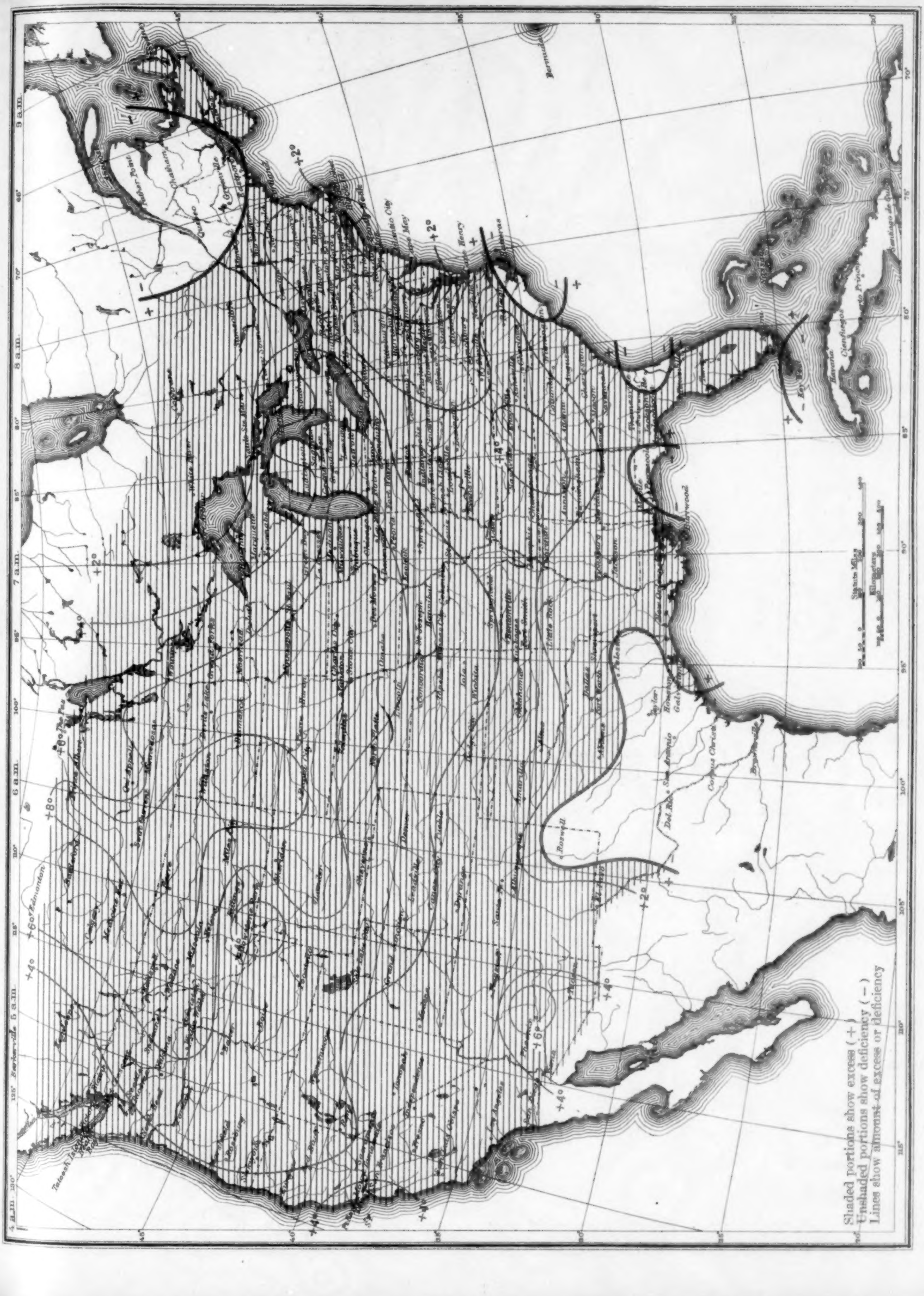
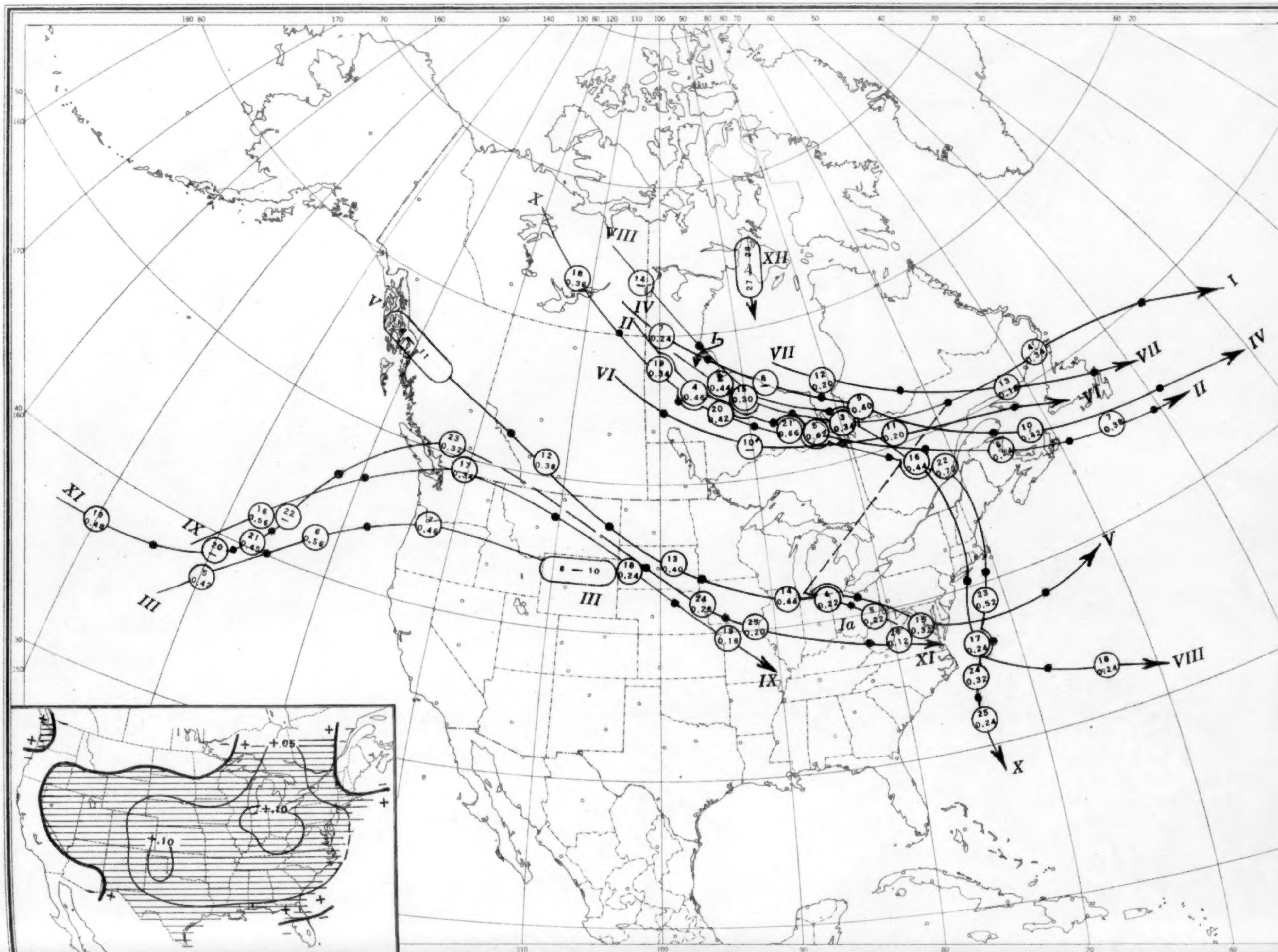


Chart II. Tracks of Centers of Anticyclones, May 1936. (Inset) Departure of Monthly Mean Pressure from Normal

(Plotted by W. P. Day)



Circle indicates position of anticyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of anticyclone at 8 p. m. (75th meridian time).

Chart III. Tracks of Centers of Cyclones, May 1936. (Inset) Change in Mean Pressure from Preceding Month

Chart III. Tracks of Centers of Cyclones, May 1936. (Inset) Change in Mean Pressure from Preceding Month
(Plotted by W. P. Day)

Circle indicates position of cyclone at 8 a. m. (75th meridian time), with barometric reading. Dot indicates position of cyclone at 8 p. m. (75th meridian time).

Chart IV. Percentage of Clear Sky Between Sunrise and Sunset, May 1936

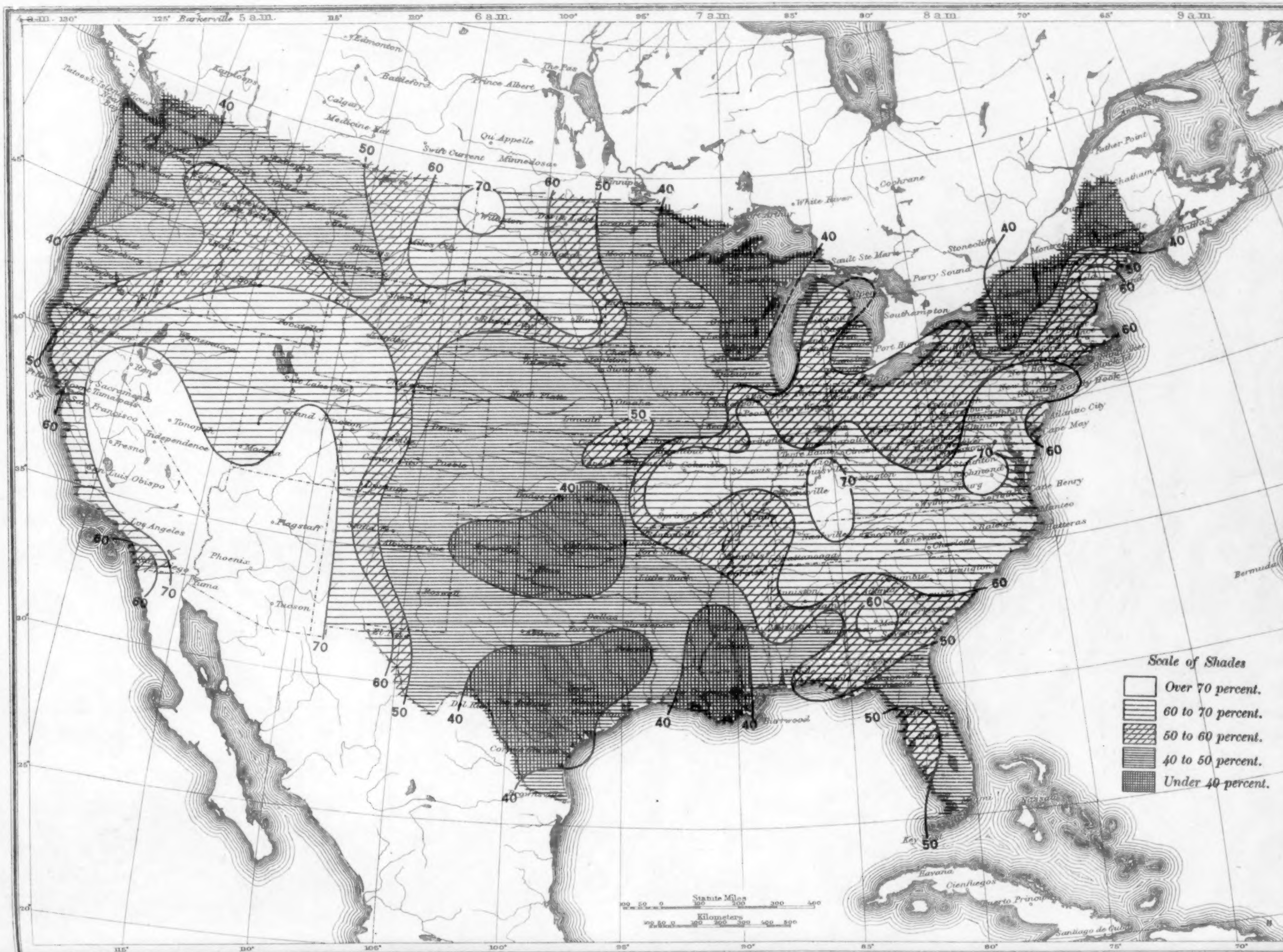


Chart V. Total Precipitation, Inches, May 1936. (Inset) Departure of Precipitation from Normal

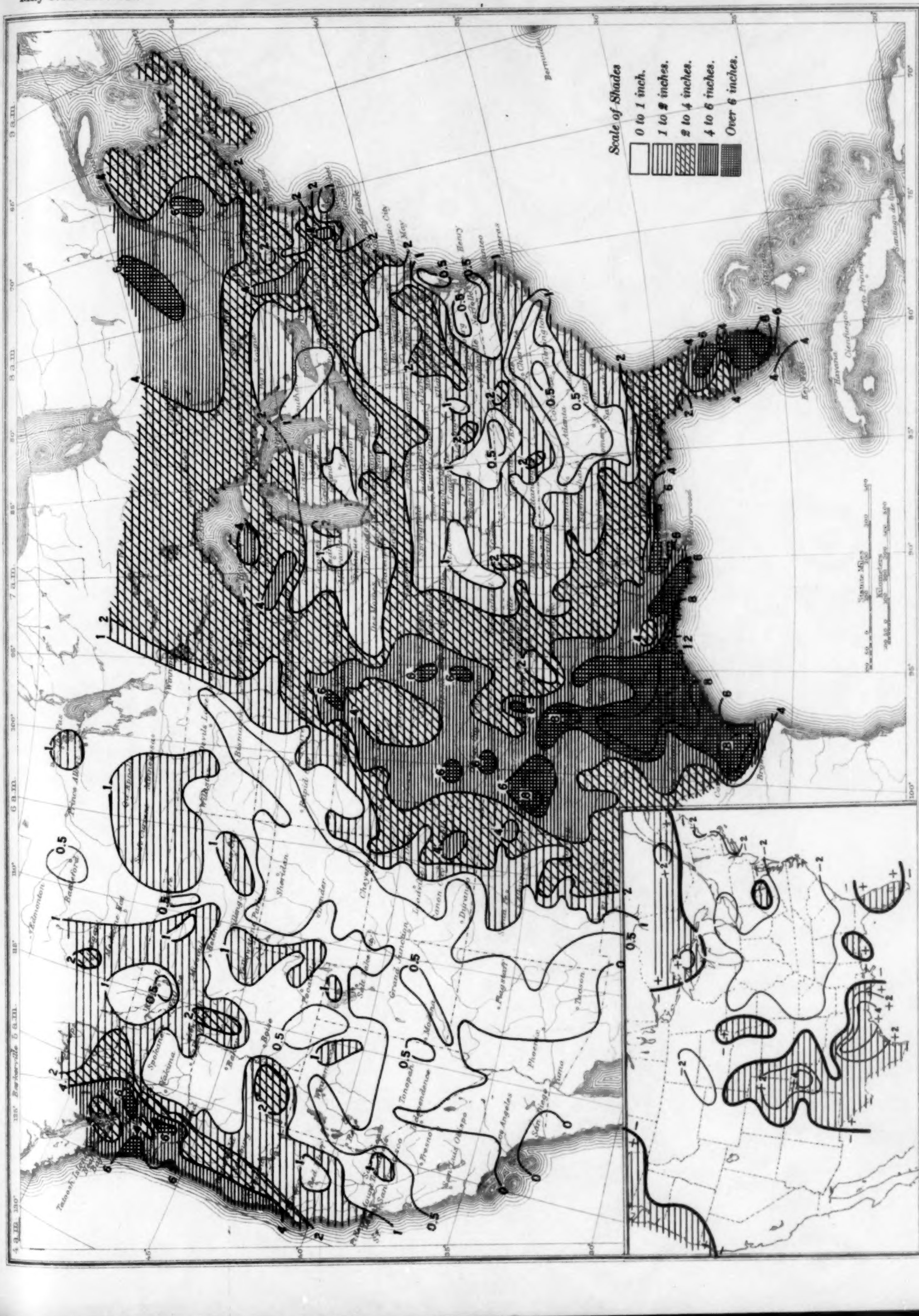


Chart V. Total Precipitation, Inches, May 1936. (Inset) Departure of Precipitation from Normal

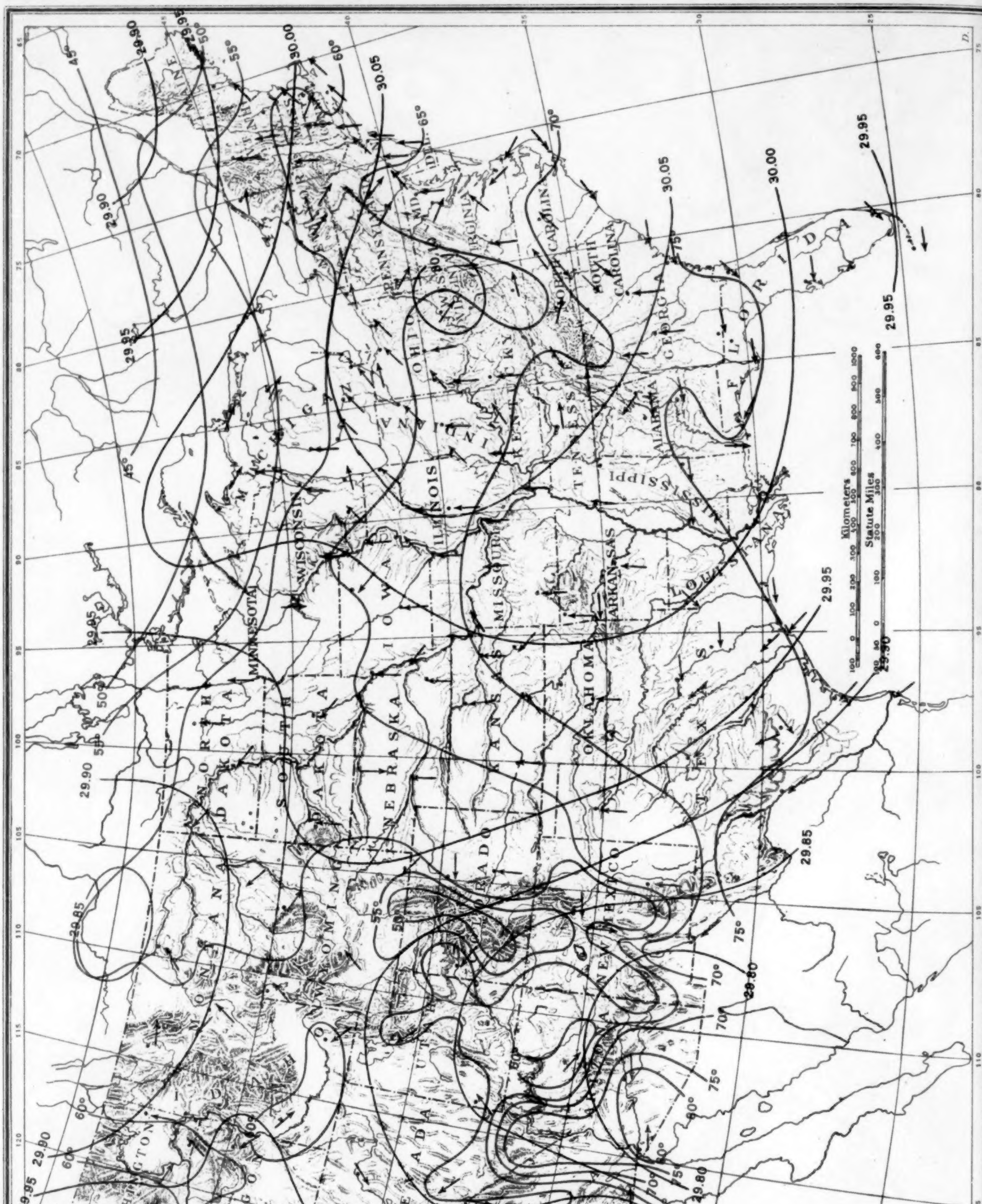


Chart VI. Isobars at Sea Level and Isotherms at Surface; Prevailing Winds, May 1936

Wind Roses for Selected Stations, May 1936
(Plotted by W. W. Reed)